

TCP/IP Simulation

TCP/IP is the protocol responsible for routing messages around the Internet. These materials contain everything you need to run a fun and informative simulation of TCP/IP in your classroom, for any number of students. We once ran this simulation with 200 students in a gymnasium!

Objectives

This simulation is designed to allow students to experience and participate in the TCP/IP protocol, a core component of networking. This experience will make future learning experiences more impactful, by providing a context for asking and reasoning about questions such as:

- How do messages get transferred between the billions of computers on the Internet?
- When a new computer joins the Internet, how do all the other computers find out how to send it messages?
- Can other people see the messages I send over the Internet?
- What happens when a message from one computer to another can't be delivered?

Background

The Internet is organized into networks. There is one top-level network (the "backbone" of the Internet, powered by huge data centers and connected by undersea cables), with smaller subnetworks attached. Smaller subnetworks are attached to those, on and on.

TCP/IP is a distributed protocol: there is no overall map of the network and nobody is in charge. Instead, each computer plays its part and the whole system works. Several roles are included in this simulation:

- **Regular nodes** are normal computers on a network. Their job is to receive messages passed to them, and to pass along any messages which are not addressed to them. Regular nodes can also send messages.
- **Gateway nodes** are part of two networks: their main network, and a subnetwork. Like regular nodes, gateway nodes can send and receive messages. But when they receive a message not addressed to them, gateway nodes need to determine whether the message should be routed to their subnetwork or to their main network.
- **Nameservers** maintain an "address book" of each person's IP address. Whenever anyone wants to send a message, they must address it to an IP address. So they must first send a message to their nameserver asking for the person's IP address.

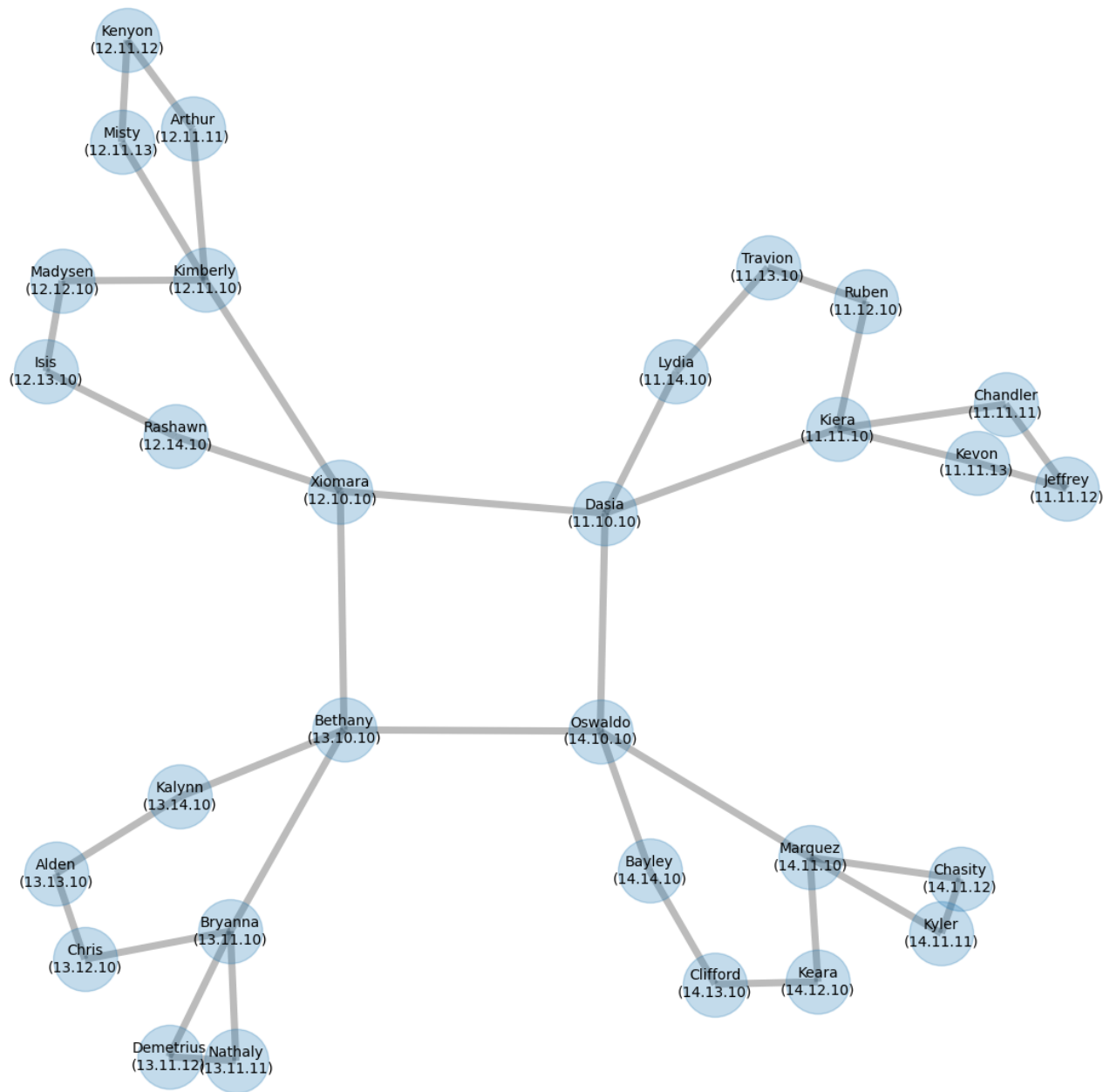
Setup

First, use the `tcp_ip_simulation` software package to generate materials for your specific group of participants. If you are reading this, you have probably already generated your materials. Otherwise, please refer to the software documentation at <https://github.com/cproctor/tcp-ip-simulation>.

Room setup

You will need to arrange your classroom for this activity. Each network needs to be roughly a circle, with enough space for all the members of that network, each person within arm's reach of their neighbors. A network could be a circle of chairs or desks, a table, or a loop of string or tape on the floor, if your floors are clean enough to sit on! Label Network 0 in some way--each participant will use this label to figure out where to sit.

Start by creating Network 0 in the middle of the room, with enough room for the following people: Dasia, Xiomara, Bethany and Oswaldo. Then create your additional networks, 11, 11.11, 12, 12.11, 13, 13.11, 14 and 14.11. Each of these networks needs its own loop (again, a circle of chairs, a table, or a loop on the floor), and should touch its parent network. Label each network (e.g. with a sheet of paper in the center). Here's a map of all the networks and their members:



11.10.10 Dasia (gateway for network 11) (nameserver: Chandler)
 11.11.10 Kiera (gateway for network 11.11) (nameserver: Chandler)
 11.11.11 Chandler (nameserver)
 11.11.12 Jeffrey (node) (nameserver: Chandler)
 11.11.13 Kevon (node) (nameserver: Chandler)
 11.12.10 Ruben (node) (nameserver: Chandler)
 11.13.10 Travion (nameserver)
 11.14.10 Lydia (node) (nameserver: Travion)
 12.10.10 Xiomara (gateway for network 12) (nameserver: Arthur)
 12.11.10 Kimberly (gateway for network 12.11) (nameserver: Arthur)
 12.11.11 Arthur (nameserver)
 12.11.12 Kenyon (node) (nameserver: Arthur)
 12.11.13 Misty (node) (nameserver: Arthur)
 12.12.10 Madysen (node) (nameserver: Arthur)
 12.13.10 Isis (node) (nameserver: Travion)
 12.14.10 Rashawn (node) (nameserver: Travion)
 13.10.10 Bethany (gateway for network 13) (nameserver: Nathaly)
 13.11.10 Bryanna (gateway for network 13.11) (nameserver: Nathaly)

13.11.11 Nathaly (nameserver)
13.11.12 Demetrius (node) (nameserver: Nathaly)
13.12.10 Chris (node) (nameserver: Nathaly)
13.13.10 Alden (node) (nameserver: Nathaly)
13.14.10 Kalynn (node) (nameserver: Travion)
14.10.10 Oswaldo (gateway for network 14) (nameserver: Kyler)
14.11.10 Marquez (gateway for network 14.11) (nameserver: Kyler)
14.11.11 Kyler (nameserver)
14.11.12 Chasity (node) (nameserver: Kyler)
14.12.10 Keara (node) (nameserver: Kyler)
14.13.10 Clifford (node) (nameserver: Kyler)
14.14.10 Bayley (node) (nameserver: Travion)

In case you need it, here's a directory of every participant's IP address:

- Alden: 13.13.10
- Arthur: 12.11.11
- Bayley: 14.14.10
- Bethany: 13.10.10
- Bryanna: 13.11.10
- Chandler: 11.11.11
- Chasity: 14.11.12
- Chris: 13.12.10
- Clifford: 14.13.10
- Dasia: 11.10.10
- Demetrius: 13.11.12
- Isis: 12.13.10
- Jeffrey: 11.11.12
- Kalynn: 13.14.10
- Keara: 14.12.10
- Kenyon: 12.11.12
- Kevon: 11.11.13
- Kiera: 11.11.10
- Kimberly: 12.11.10
- Kyler: 14.11.11
- Lydia: 11.14.10
- Madysen: 12.12.10
- Marquez: 14.11.10
- Misty: 12.11.13
- Nathaly: 13.11.11
- Oswaldo: 14.10.10
- Rashawn: 12.14.10
- Ruben: 11.12.10
- Travion: 11.13.10
- Xiomara: 12.10.10

Materials

In addition to these instructions, you will need a lot of small sheets of paper--about ten per person (300 sheets total) is about right. Scrap paper from the copyroom cut into quarters works perfectly.

Lesson plan

This lesson is designed for a 50-minute class period. If you have extra time, there are plenty of extensions you can explore in a second class period. Spend as little time as possible introducing the lesson--it's best to jump right in.

Setup: Hand out the individual instruction sheets which were generated with these instructions and ask students to complete the tasks under "setup." These are different for each person.

Demo: Tell students you are going to demonstrate the "Receiving messages" and "Sending messages" instructions on their instruction sheets, and ask them to read over these instructions for a minute. Then choose two students who are "regular nodes" on different subnets and model how one would send a message to the other.

For example, Kyler will send a message to Chasity. Follow these steps:

1. Kyler (whose IP address is 14.11.11) needs to find out Chasity's IP address. To do this, Kyler needs to consult their nameserver, whose IP address is 14.11.11 (assigned in Chasity's instructions). Write the following message on a sheet of paper:

To: 14.11.11
From: 14.11.11
Message: What is Chasity's address?

Note that "from" and "to" must be IP addresses, not people's names. Other than "from", "to", and "message", messages may not contain anything else. If anyone ever gets a malformed message, they should feel free to crumple it up and throw it away.

2. Now Kyler should hand this message to the person to their right. Each person should follow their own "Receiving messages" instructions until the message reaches Kyler, the nameserver. Nameservers have a list of everyone's IP address, so Kyler can write a reply:

To: 14.11.11
From: 14.11.11
Message: Chasity's address is 14.11.12.

3. Now this reply needs to be delivered. Chasity hands the message to the person to their right, and once again each person follows their own instructions until the message reaches Kyler.
4. Now that Kyler knows Chasity's address, they can finally send a message:

To: 14.11.12
From: 14.11.11
Message: Hey, it's Kyler. What are you doing after school today?

5. One last time, Kyler hands the message to their right, and everyone else follows their own instructions until the message is delivered.

Round 1. In the first round of the simulation, everyone should do their best to make things work smoothly. The teacher should focus on helping people who get stuck. After a suitable amount of time, once messages are finding their way around properly, stop the simulation.

Discussion. Ask students to share anything they noticed or anything they wondered. Common responses include:

- Sometimes people send messages and they just disappear. (Is there anything you can do other than re-sending?)
- Sometimes nameservers or gateway routers get backed up, with large piles of messages. Hopefully this was funny rather than stressful. (When someone gets backed up, what should they do?)
- Students often complain that other people are reading their messages. (What could be done about this?)
- If you have a sufficiently trusting and playful classroom culture, some students may have gotten up to some mischief, such as spoofing other users (sending messages that claim to be from someone else), replacing messages in transit with different messages, censoring messages, etc. (These are all real issues in networks. How could they be dealt with?)

Round 2 Run another round of the simulation. If things went well in Round 1, consider adding a challenge or interfering with the network. Possible challenges:

- With the class, agree on a policy to address an issue that came up in Round 1, and see how well it works.
- Send a long, multi-part letter to someone else, using multiple messages.
- Find a way to send a secret message to someone else.

Possible forms of interference:

- Start randomly intercepting messages and throwing them away.
- Create a message whose "to" address does not exist (it will go around and around forever, until someone gets tired of it and throws it away!)
- Quietly encourage a student to begin some of the mischief described above: spoofing other users (sending messages that claim to be from someone else), replacing messages in transit with different messages, or censoring messages.

Concluding discussion. Once again, ask students to share anything they noticed or anything they wondered. Depending on what additional lessons you are planning to teach on networking, it may be valuable to write these down somewhere in the classroom so you can refer back to them.

Dasia (IP Address: 11.10.10)

You are a gateway router, responsible for directing traffic between two networks. Your nameserver is 11.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find the place where network 0 meets network 11 and sit so you can touch both circles.
- Notice who is to your right (-->) along the circle of network 0. Then notice who is to your right along network 11.

Receiving messages

- When you are handed a message, check to see if it's for you (11.10.10). If so, keep it. (And write back!)
- Otherwise, check whether the message was sent to an IP address that starts with 11.
 - If it starts with 11, pass it to the right along network 11.
 - Otherwise, pass it to the right along network 0.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right (if the address starts with 11, pass it to the right on network 11; otherwise pass it to the right on network 0).
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 11.11.11 From: 11.10.10 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 11.10.10 Message: Hi Toodle! It's Dasia. Are you going to Homework Club today?
--

Xiomara (IP Address: 12.10.10)

You are a gateway router, responsible for directing traffic between two networks. Your nameserver is 12.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find the place where network 0 meets network 12 and sit so you can touch both circles.
- Notice who is to your right (-->) along the circle of network 0. Then notice who is to your right along network 12.

Receiving messages

- When you are handed a message, check to see if it's for you (12.10.10). If so, keep it. (And write back!)
- Otherwise, check whether the message was sent to an IP address that starts with 12.
 - If it starts with 12, pass it to the right along network 12.
 - Otherwise, pass it to the right along network 0.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right (if the address starts with 12, pass it to the right on network 12; otherwise pass it to the right on network 0).
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 12.11.11 From: 12.10.10 Message: What is Toodle Oo's address?
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- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 12.10.10 Message: Hi Toodle! It's Xiomara. Are you going to Homework Club today?
--

Bethany (IP Address: 13.10.10)

You are a gateway router, responsible for directing traffic between two networks. Your nameserver is 13.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find the place where network 0 meets network 13 and sit so you can touch both circles.
- Notice who is to your right (-->) along the circle of network 0. Then notice who is to your right along network 13.

Receiving messages

- When you are handed a message, check to see if it's for you (13.10.10). If so, keep it. (And write back!)
- Otherwise, check whether the message was sent to an IP address that starts with 13.
 - If it starts with 13, pass it to the right along network 13.
 - Otherwise, pass it to the right along network 0.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right (if the address starts with 13, pass it to the right on network 13; otherwise pass it to the right on network 0).
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 13.11.11 From: 13.10.10 Message: What is Toodle Oo's address?
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- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 13.10.10 Message: Hi Toodle! It's Bethany. Are you going to Homework Club today?
--

Oswaldo (IP Address: 14.10.10)

You are a gateway router, responsible for directing traffic between two networks. Your nameserver is 14.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find the place where network 0 meets network 14 and sit so you can touch both circles.
- Notice who is to your right (-->) along the circle of network 0. Then notice who is to your right along network 14.

Receiving messages

- When you are handed a message, check to see if it's for you (14.10.10). If so, keep it. (And write back!)
- Otherwise, check whether the message was sent to an IP address that starts with 14.
 - If it starts with 14, pass it to the right along network 14.
 - Otherwise, pass it to the right along network 0.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right (if the address starts with 14, pass it to the right on network 14; otherwise pass it to the right on network 0).
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 14.11.11 From: 14.10.10 Message: What is Toodle Oo's address?
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- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 14.10.10 Message: Hi Toodle! It's Oswaldo. Are you going to Homework Club today?
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Kiera (IP Address: 11.11.10)

You are a gateway router, responsible for directing traffic between two networks. Your nameserver is 11.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find the place where network 11 meets network 11.11 and sit so you can touch both circles.
- Notice who is to your right (-->) along the circle of network 11. Then notice who is to your right along network 11.11.

Receiving messages

- When you are handed a message, check to see if it's for you (11.11.10). If so, keep it. (And write back!)
- Otherwise, check whether the message was sent to an IP address that starts with 11.11.
 - If it starts with 11.11, pass it to the right along network 11.11.
 - Otherwise, pass it to the right along network 11.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right (if the address starts with 11.11, pass it to the right on network 11.11; otherwise pass it to the right on network 11).
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 11.11.11 From: 11.11.10 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 11.11.10 Message: Hi Toodle! It's Kiera. Are you going to Homework Club today?
--

Ruben (IP Address: 11.12.10)

You are an ordinary computer on the Internet. Your nameserver is 11.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find network 11 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 11.

Receiving messages

- When you are handed a message, check to see if it's for you (11.12.10). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 11.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 11 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 11.11.11 From: 11.12.10 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 11.12.10 Message: Hi Toodle! It's Ruben. Are you going to Homework Club today?
--

Travion (IP Address: 11.13.10)

You are a nameserver, responsible for looking up addresses for your clients.

Setup

- Make sure you have a pen or a pencil.
- Find network 11 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 11.

Receiving messages

- When you are handed a message, check to see if it's for you (11.13.10). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 11.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 11 as usual.
- You can send messages to whoever you want. First, use your Directory to look up the address of the person you would like to write to. Then write a message:

<p>To: 16.17.18 From: 11.13.10 Message: Hi Toodle! It's Travion. Are you going to Homework Club today?</p>

- You are a nameserver, so most of the messages you receive will be requests for somebody's IP address. Use the Directory to look up the requested name, and write back.

Directory

- Alden: 13.13.10
- Arthur: 12.11.11
- Bayley: 14.14.10
- Bethany: 13.10.10
- Bryanna: 13.11.10
- Chandler: 11.11.11
- Chasity: 14.11.12
- Chris: 13.12.10
- Clifford: 14.13.10
- Dasia: 11.10.10
- Demetrius: 13.11.12
- Isis: 12.13.10
- Jeffrey: 11.11.12
- Kalynn: 13.14.10
- Keara: 14.12.10
- Kenyon: 12.11.12
- Kevon: 11.11.13
- Kiera: 11.11.10
- Kimberly: 12.11.10
- Kyler: 14.11.11
- Lydia: 11.14.10
- Madysen: 12.12.10
- Marquez: 14.11.10
- Misty: 12.11.13
- Nathaly: 13.11.11
- Oswaldo: 14.10.10
- Rashawn: 12.14.10

- Ruben: 11.12.10
- Travion: 11.13.10
- Xiomara: 12.10.10

Lydia (IP Address: 11.14.10)

You are an ordinary computer on the Internet. Your nameserver is 11.13.10.

Setup

- Make sure you have a pen or a pencil.
- Find network 11 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 11.

Receiving messages

- When you are handed a message, check to see if it's for you (11.14.10). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 11.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 11 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 11.13.10 From: 11.14.10 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 11.14.10 Message: Hi Toodle! It's Lydia. Are you going to Homework Club today?
--

Chandler (IP Address: 11.11.11)

You are a nameserver, responsible for looking up addresses for your clients.

Setup

- Make sure you have a pen or a pencil.
- Find network 11.11 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 11.11.

Receiving messages

- When you are handed a message, check to see if it's for you (11.11.11). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 11.11.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 11.11 as usual.
- You can send messages to whoever you want. First, use your Directory to look up the address of the person you would like to write to. Then write a message:

<p>To: 16.17.18 From: 11.11.11 Message: Hi Toodle! It's Chandler. Are you going to Homework Club today?</p>
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- You are a nameserver, so most of the messages you receive will be requests for somebody's IP address. Use the Directory to look up the requested name, and write back.

Directory

- Alden: 13.13.10
- Arthur: 12.11.11
- Bayley: 14.14.10
- Bethany: 13.10.10
- Bryanna: 13.11.10
- Chandler: 11.11.11
- Chasity: 14.11.12
- Chris: 13.12.10
- Clifford: 14.13.10
- Dasia: 11.10.10
- Demetrius: 13.11.12
- Isis: 12.13.10
- Jeffrey: 11.11.12
- Kalynn: 13.14.10
- Keara: 14.12.10
- Kenyon: 12.11.12
- Kevon: 11.11.13
- Kiera: 11.11.10
- Kimberly: 12.11.10
- Kyler: 14.11.11
- Lydia: 11.14.10
- Madysen: 12.12.10
- Marquez: 14.11.10
- Misty: 12.11.13
- Nathaly: 13.11.11
- Oswaldo: 14.10.10
- Rashawn: 12.14.10

- Ruben: 11.12.10
- Travion: 11.13.10
- Xiomara: 12.10.10

Jeffrey (IP Address: 11.11.12)

You are an ordinary computer on the Internet. Your nameserver is 11.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find network 11.11 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 11.11.

Receiving messages

- When you are handed a message, check to see if it's for you (11.11.12). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 11.11.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 11.11 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 11.11.11 From: 11.11.12 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 11.11.12 Message: Hi Toodle! It's Jeffrey. Are you going to Homework Club today?
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Kevon (IP Address: 11.11.13)

You are an ordinary computer on the Internet. Your nameserver is 11.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find network 11.11 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 11.11.

Receiving messages

- When you are handed a message, check to see if it's for you (11.11.13). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 11.11.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 11.11 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 11.11.11 From: 11.11.13 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 11.11.13 Message: Hi Toodle! It's Kevon. Are you going to Homework Club today?
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Kimberly (IP Address: 12.11.10)

You are a gateway router, responsible for directing traffic between two networks. Your nameserver is 12.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find the place where network 12 meets network 12.11 and sit so you can touch both circles.
- Notice who is to your right (-->) along the circle of network 12. Then notice who is to your right along network 12.11.

Receiving messages

- When you are handed a message, check to see if it's for you (12.11.10). If so, keep it. (And write back!)
- Otherwise, check whether the message was sent to an IP address that starts with 12.11.
 - If it starts with 12.11, pass it to the right along network 12.11.
 - Otherwise, pass it to the right along network 12.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right (if the address starts with 12.11, pass it to the right on network 12.11; otherwise pass it to the right on network 12).
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 12.11.11 From: 12.11.10 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 12.11.10 Message: Hi Toodle! It's Kimberly. Are you going to Homework Club today?

Madysen (IP Address: 12.12.10)

You are an ordinary computer on the Internet. Your nameserver is 12.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find network 12 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 12.

Receiving messages

- When you are handed a message, check to see if it's for you (12.12.10). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 12.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 12 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 12.11.11 From: 12.12.10 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 12.12.10 Message: Hi Toodle! It's Madysen. Are you going to Homework Club today?
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Isis (IP Address: 12.13.10)

You are an ordinary computer on the Internet. Your nameserver is 11.13.10.

Setup

- Make sure you have a pen or a pencil.
- Find network 12 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 12.

Receiving messages

- When you are handed a message, check to see if it's for you (12.13.10). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 12.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 12 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 11.13.10 From: 12.13.10 Message: What is Toodie Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 12.13.10 Message: Hi Toodie! It's Isis. Are you going to Homework Club today?

Rashawn (IP Address: 12.14.10)

You are an ordinary computer on the Internet. Your nameserver is 11.13.10.

Setup

- Make sure you have a pen or a pencil.
- Find network 12 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 12.

Receiving messages

- When you are handed a message, check to see if it's for you (12.14.10). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 12.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 12 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 11.13.10 From: 12.14.10 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 12.14.10 Message: Hi Toodle! It's Rashawn. Are you going to Homework Club today?
--

Arthur (IP Address: 12.11.11)

You are a nameserver, responsible for looking up addresses for your clients.

Setup

- Make sure you have a pen or a pencil.
- Find network 12.11 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 12.11.

Receiving messages

- When you are handed a message, check to see if it's for you (12.11.11). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 12.11.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 12.11 as usual.
- You can send messages to whoever you want. First, use your Directory to look up the address of the person you would like to write to. Then write a message:

<p>To: 16.17.18 From: 12.11.11 Message: Hi Toodle! It's Arthur. Are you going to Homework Club today?</p>
--

- You are a nameserver, so most of the messages you receive will be requests for somebody's IP address. Use the Directory to look up the requested name, and write back.

Directory

- Alden: 13.13.10
- Arthur: 12.11.11
- Bayley: 14.14.10
- Bethany: 13.10.10
- Bryanna: 13.11.10
- Chandler: 11.11.11
- Chasity: 14.11.12
- Chris: 13.12.10
- Clifford: 14.13.10
- Dasia: 11.10.10
- Demetrius: 13.11.12
- Isis: 12.13.10
- Jeffrey: 11.11.12
- Kalynn: 13.14.10
- Keara: 14.12.10
- Kenyon: 12.11.12
- Kevon: 11.11.13
- Kiera: 11.11.10
- Kimberly: 12.11.10
- Kyler: 14.11.11
- Lydia: 11.14.10
- Madysen: 12.12.10
- Marquez: 14.11.10
- Misty: 12.11.13
- Nathaly: 13.11.11
- Oswaldo: 14.10.10
- Rashawn: 12.14.10

- Ruben: 11.12.10
- Travion: 11.13.10
- Xiomara: 12.10.10

Kenyon (IP Address: 12.11.12)

You are an ordinary computer on the Internet. Your nameserver is 12.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find network 12.11 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 12.11.

Receiving messages

- When you are handed a message, check to see if it's for you (12.11.12). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 12.11.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 12.11 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 12.11.11 From: 12.11.12 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 12.11.12 Message: Hi Toodle! It's Kenyon. Are you going to Homework Club today?

Misty (IP Address: 12.11.13)

You are an ordinary computer on the Internet. Your nameserver is 12.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find network 12.11 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 12.11.

Receiving messages

- When you are handed a message, check to see if it's for you (12.11.13). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 12.11.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 12.11 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 12.11.11 From: 12.11.13 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 12.11.13 Message: Hi Toodle! It's Misty. Are you going to Homework Club today?
--

Bryanna (IP Address: 13.11.10)

You are a gateway router, responsible for directing traffic between two networks. Your nameserver is 13.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find the place where network 13 meets network 13.11 and sit so you can touch both circles.
- Notice who is to your right (-->) along the circle of network 13. Then notice who is to your right along network 13.11.

Receiving messages

- When you are handed a message, check to see if it's for you (13.11.10). If so, keep it. (And write back!)
- Otherwise, check whether the message was sent to an IP address that starts with 13.11.
 - If it starts with 13.11, pass it to the right along network 13.11.
 - Otherwise, pass it to the right along network 13.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right (if the address starts with 13.11, pass it to the right on network 13.11; otherwise pass it to the right on network 13).
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 13.11.11 From: 13.11.10 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 13.11.10 Message: Hi Toodle! It's Bryanna. Are you going to Homework Club today?
--

Chris (IP Address: 13.12.10)

You are an ordinary computer on the Internet. Your nameserver is 13.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find network 13 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 13.

Receiving messages

- When you are handed a message, check to see if it's for you (13.12.10). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 13.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 13 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 13.11.11 From: 13.12.10 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 13.12.10 Message: Hi Toodle! It's Chris. Are you going to Homework Club today?
--

Alden (IP Address: 13.13.10)

You are an ordinary computer on the Internet. Your nameserver is 13.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find network 13 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 13.

Receiving messages

- When you are handed a message, check to see if it's for you (13.13.10). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 13.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 13 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 13.11.11 From: 13.13.10 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 13.13.10 Message: Hi Toodle! It's Alden. Are you going to Homework Club today?
--

Kalynn (IP Address: 13.14.10)

You are an ordinary computer on the Internet. Your nameserver is 11.13.10.

Setup

- Make sure you have a pen or a pencil.
- Find network 13 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 13.

Receiving messages

- When you are handed a message, check to see if it's for you (13.14.10). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 13.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 13 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 11.13.10 From: 13.14.10 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 13.14.10 Message: Hi Toodle! It's Kalynn. Are you going to Homework Club today?

Nathaly (IP Address: 13.11.11)

You are a nameserver, responsible for looking up addresses for your clients.

Setup

- Make sure you have a pen or a pencil.
- Find network 13.11 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 13.11.

Receiving messages

- When you are handed a message, check to see if it's for you (13.11.11). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 13.11.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 13.11 as usual.
- You can send messages to whoever you want. First, use your Directory to look up the address of the person you would like to write to. Then write a message:

<p>To: 16.17.18 From: 13.11.11 Message: Hi Toodle! It's Nathaly. Are you going to Homework Club today?</p>

- You are a nameserver, so most of the messages you receive will be requests for somebody's IP address. Use the Directory to look up the requested name, and write back.

Directory

- Alden: 13.13.10
- Arthur: 12.11.11
- Bayley: 14.14.10
- Bethany: 13.10.10
- Bryanna: 13.11.10
- Chandler: 11.11.11
- Chasity: 14.11.12
- Chris: 13.12.10
- Clifford: 14.13.10
- Dasia: 11.10.10
- Demetrius: 13.11.12
- Isis: 12.13.10
- Jeffrey: 11.11.12
- Kalynn: 13.14.10
- Keara: 14.12.10
- Kenyon: 12.11.12
- Kevon: 11.11.13
- Kiera: 11.11.10
- Kimberly: 12.11.10
- Kyler: 14.11.11
- Lydia: 11.14.10
- Madysen: 12.12.10
- Marquez: 14.11.10
- Misty: 12.11.13
- Nathaly: 13.11.11
- Oswaldo: 14.10.10
- Rashawn: 12.14.10

- Ruben: 11.12.10
- Travion: 11.13.10
- Xiomara: 12.10.10

Demetrius (IP Address: 13.11.12)

You are an ordinary computer on the Internet. Your nameserver is 13.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find network 13.11 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 13.11.

Receiving messages

- When you are handed a message, check to see if it's for you (13.11.12). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 13.11.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 13.11 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 13.11.11 From: 13.11.12 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 13.11.12 Message: Hi Toodle! It's Demetrius. Are you going to Homework Club today?
--

Marquez (IP Address: 14.11.10)

You are a gateway router, responsible for directing traffic between two networks. Your nameserver is 14.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find the place where network 14 meets network 14.11 and sit so you can touch both circles.
- Notice who is to your right (-->) along the circle of network 14. Then notice who is to your right along network 14.11.

Receiving messages

- When you are handed a message, check to see if it's for you (14.11.10). If so, keep it. (And write back!)
- Otherwise, check whether the message was sent to an IP address that starts with 14.11.
 - If it starts with 14.11, pass it to the right along network 14.11.
 - Otherwise, pass it to the right along network 14.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right (if the address starts with 14.11, pass it to the right on network 14.11; otherwise pass it to the right on network 14).
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 14.11.11 From: 14.11.10 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 14.11.10 Message: Hi Toodle! It's Marquez. Are you going to Homework Club today?
--

Keara (IP Address: 14.12.10)

You are an ordinary computer on the Internet. Your nameserver is 14.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find network 14 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 14.

Receiving messages

- When you are handed a message, check to see if it's for you (14.12.10). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 14.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 14 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 14.11.11 From: 14.12.10 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 14.12.10 Message: Hi Toodle! It's Keara. Are you going to Homework Club today?
--

Clifford (IP Address: 14.13.10)

You are an ordinary computer on the Internet. Your nameserver is 14.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find network 14 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 14.

Receiving messages

- When you are handed a message, check to see if it's for you (14.13.10). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 14.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 14 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 14.11.11 From: 14.13.10 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 14.13.10 Message: Hi Toodle! It's Clifford. Are you going to Homework Club today?

Bayley (IP Address: 14.14.10)

You are an ordinary computer on the Internet. Your nameserver is 11.13.10.

Setup

- Make sure you have a pen or a pencil.
- Find network 14 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 14.

Receiving messages

- When you are handed a message, check to see if it's for you (14.14.10). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 14.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 14 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 11.13.10 From: 14.14.10 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 14.14.10 Message: Hi Toodle! It's Bayley. Are you going to Homework Club today?

Kyler (IP Address: 14.11.11)

You are a nameserver, responsible for looking up addresses for your clients.

Setup

- Make sure you have a pen or a pencil.
- Find network 14.11 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 14.11.

Receiving messages

- When you are handed a message, check to see if it's for you (14.11.11). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 14.11.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 14.11 as usual.
- You can send messages to whoever you want. First, use your Directory to look up the address of the person you would like to write to. Then write a message:

<p>To: 16.17.18 From: 14.11.11 Message: Hi Toodle! It's Kyler. Are you going to Homework Club today?</p>

- You are a nameserver, so most of the messages you receive will be requests for somebody's IP address. Use the Directory to look up the requested name, and write back.

Directory

- Alden: 13.13.10
- Arthur: 12.11.11
- Bayley: 14.14.10
- Bethany: 13.10.10
- Bryanna: 13.11.10
- Chandler: 11.11.11
- Chasity: 14.11.12
- Chris: 13.12.10
- Clifford: 14.13.10
- Dasia: 11.10.10
- Demetrius: 13.11.12
- Isis: 12.13.10
- Jeffrey: 11.11.12
- Kalynn: 13.14.10
- Keara: 14.12.10
- Kenyon: 12.11.12
- Kevon: 11.11.13
- Kiera: 11.11.10
- Kimberly: 12.11.10
- Kyler: 14.11.11
- Lydia: 11.14.10
- Madysen: 12.12.10
- Marquez: 14.11.10
- Misty: 12.11.13
- Nathaly: 13.11.11
- Oswaldo: 14.10.10
- Rashawn: 12.14.10

- Ruben: 11.12.10
- Travion: 11.13.10
- Xiomara: 12.10.10

Chasity (IP Address: 14.11.12)

You are an ordinary computer on the Internet. Your nameserver is 14.11.11.

Setup

- Make sure you have a pen or a pencil.
- Find network 14.11 and sit down on the outside of the circle.
- Notice who is to your right (-->) along the circle of network 14.11.

Receiving messages

- When you are handed a message, check to see if it's for you (14.11.12). If so, keep it. (And write back!)
- Otherwise, pass the message to the right along network 14.11.

Sending messages

- To send a message, fill out a slip of paper with "To", "From", and "Message" fields. When you are ready to send it, pass it to the right along network 14.11 as usual.
- You can send messages to whoever you want. First, ask your nameserver for your friend's IP address:

To: 14.11.11 From: 14.11.12 Message: What is Toodle Oo's address?
--

- Once your nameserver writes you back, you can write to your friend:

To: 16.17.18 From: 14.11.12 Message: Hi Toodle! It's Chasity. Are you going to Homework Club today?
--