

Domain Name System

Lawrence Snyder
University of Washington, Seattle

Recall 2 Ways To Name Computers

- **Logical:** Humans use domain names
 - `spiff.cs.washington.edu`
- **Physical:** Computers use number-quads
 - `128.208.3.136`
- This is different than the phone system:
 - The people use numbers: 1 800 555 1212
 - The equipment uses the same numbers
- A key property of computers: they can separate the logical form (preferred by people) from the physical form they must use

What's the Problem?

- The Internet is completely decentralized
 - No one is in charge – ICANN
 - A few companies get permission to give users or organizations IP-addresses – not much logic to it
 - When a person or organization gets an IP-address, it picks a domain name – few rules except to tell the company that gave it out, what the domain is
- Once connected to I'net, users start using domain name ... but when someone refers to it, how does their computer get its number??

Internet Corporation for
Assigned Names and Numbers

How do we get 128.227.205.2?

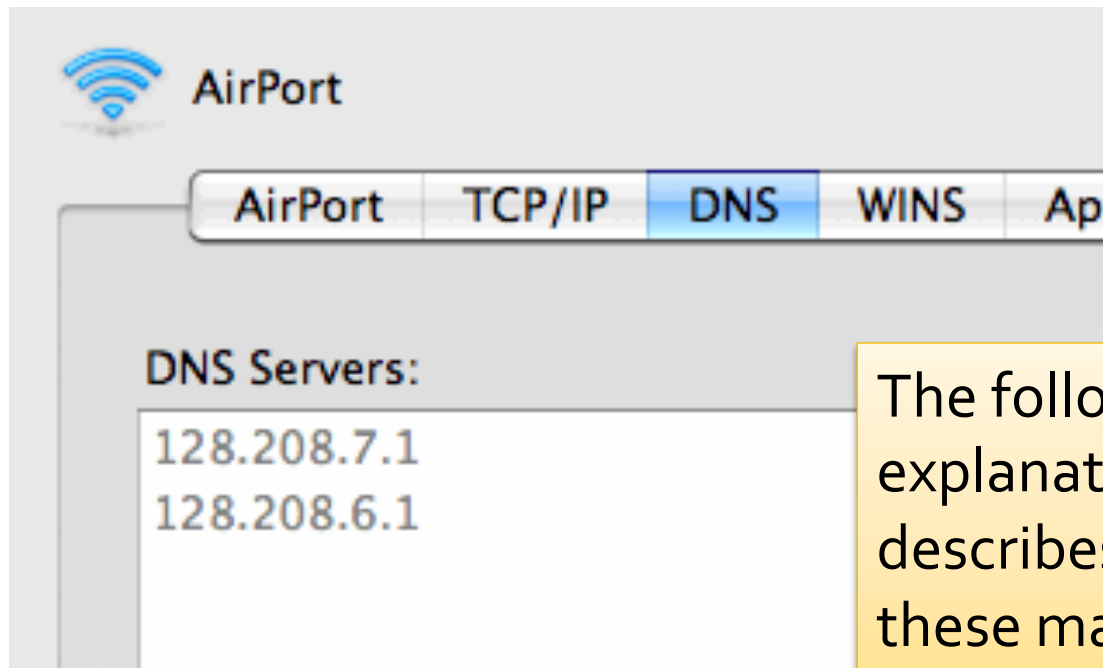
- When we send mail to a friend at the U of FL, we type friend@cise.ufl.edu and the computer that sends mail for us on campus needs to find out this fact:

cise.ufl.edu == 128.227.205.2

- We said it asks the Domain Name System, or DNS ... so what happens

But Wait!

- How does it know the address of the DNS?
- You (or someone or something who set up your computer) told it when connecting it to the network ... look in net control panel



The following explanation describes what these machines do

First Step

- The DNS server answers the question “what number is **cise.ufl.edu**?” by this method
- First Step: Look it up in its “address book”
 - The DNS server does that
 - It keeps its own address book, a list of all of the domain names like **cise.ufl.edu** that it has been asked about and found
- It checks in its address book first, looking under **cise.ufl.edu**

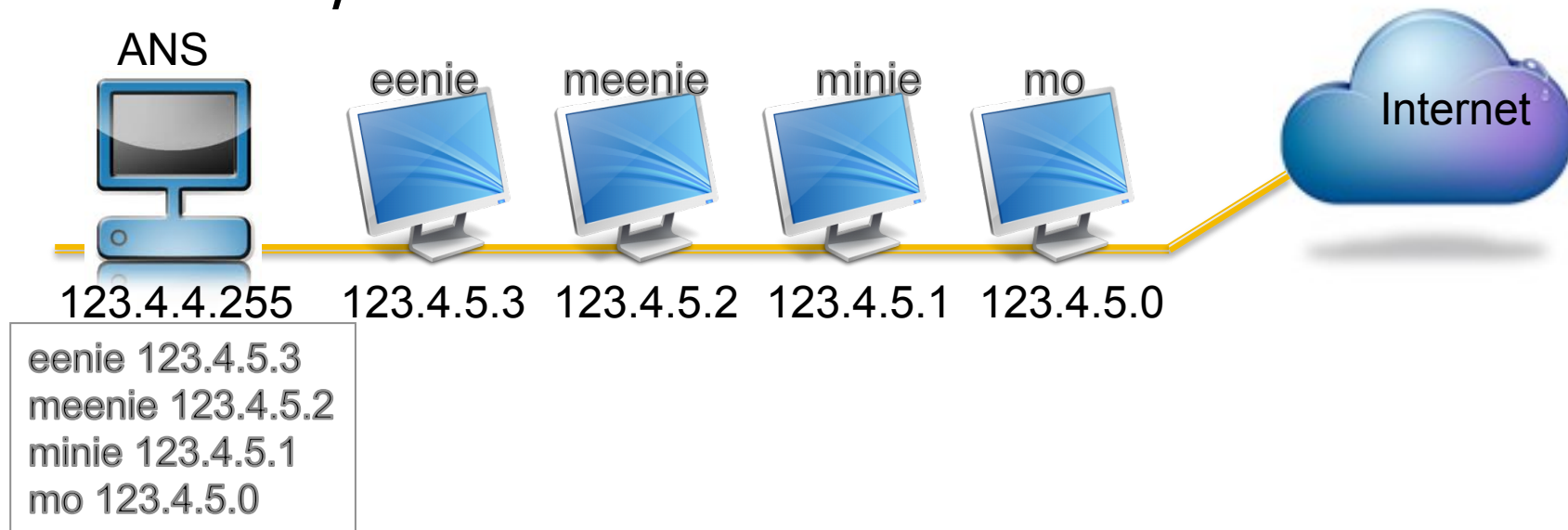
If It Has Never Been Asked ...

- The address will not be in the address book if this is the first request ...
- Second Step: The DNS server begins a process of finding the address on behalf of your computer ...

That process uses 2 Facts of I'net

The DNS Design: Fact 1

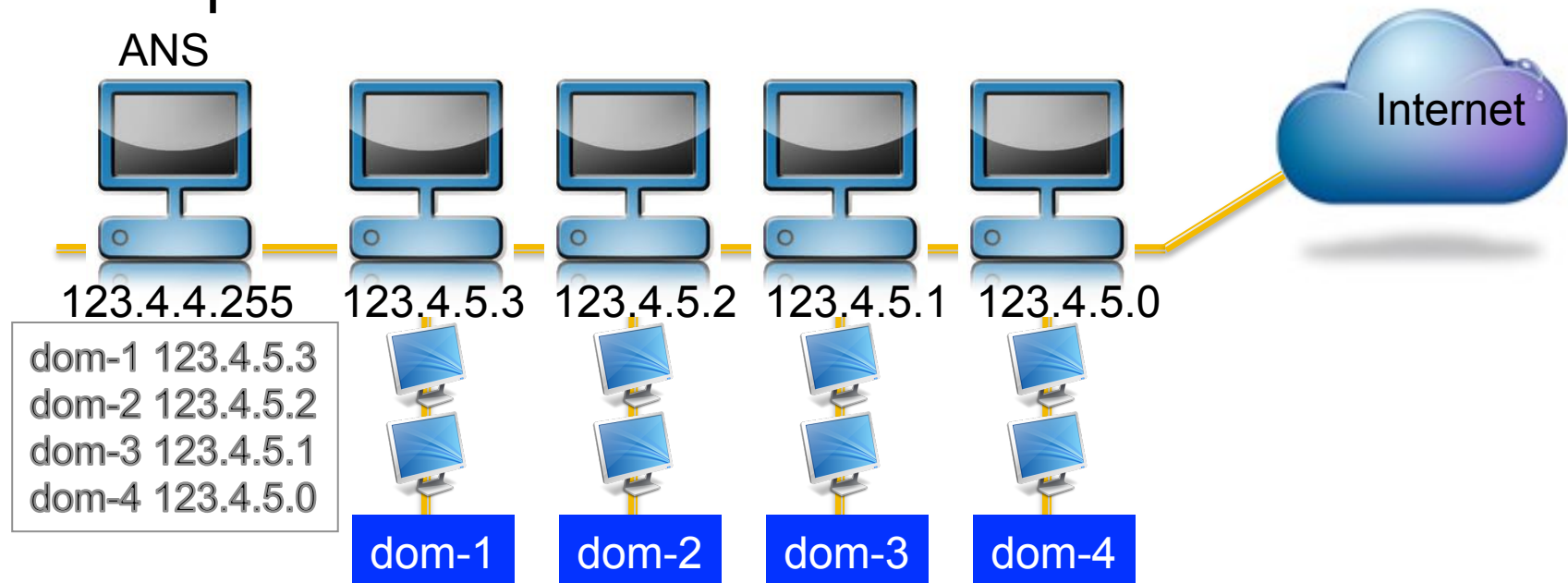
- Every domain has an authoritative name server, which I'll call ANS



- Two Cases: ANS knows the number of every computer in its domain

The DNS Design: Fact 1 (Continued)

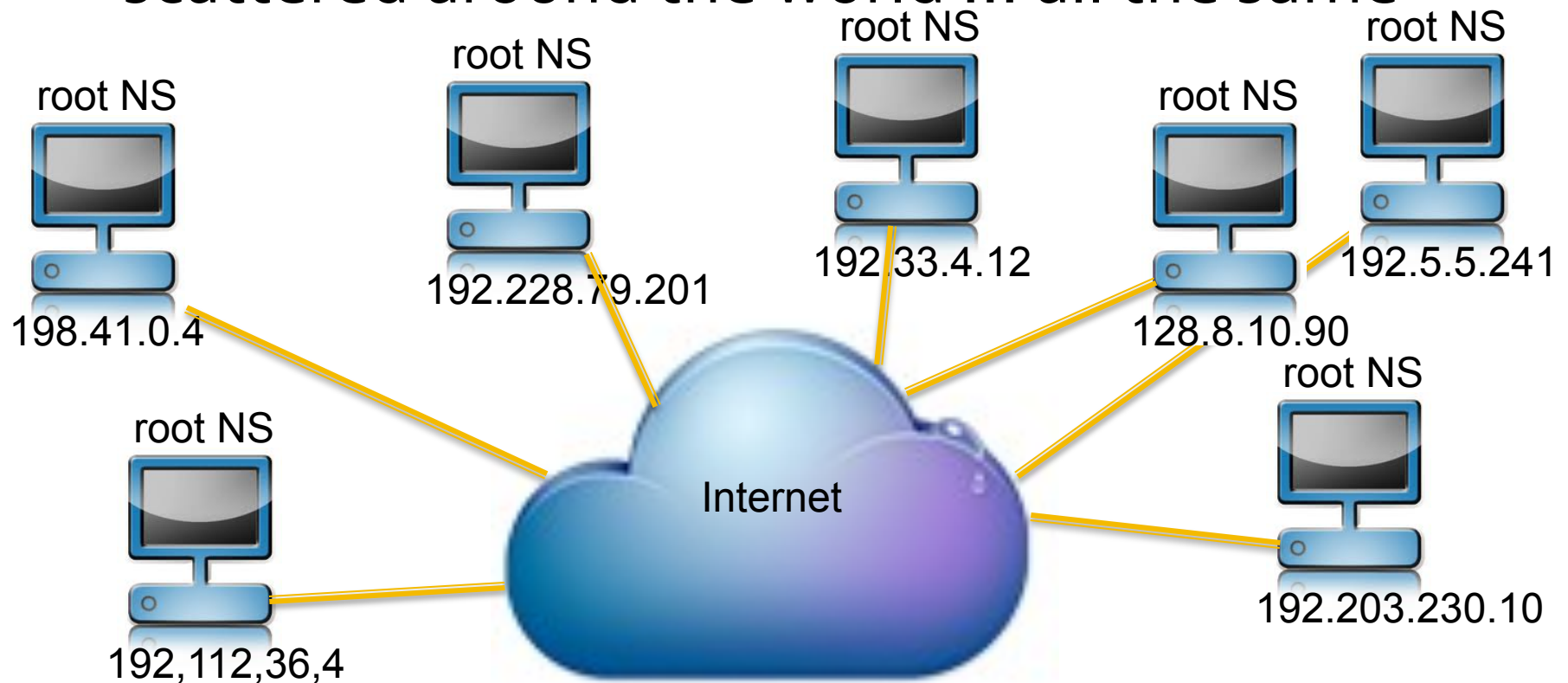
- OR ANS knows the number of every ANS computer in its domain



- For example ... think about **.edu**

The DNS Design: Fact 2

- There are 13 Internet “root name servers” scattered around the world ... all the same



- All DNS servers have their numbers

www.root-servers.org



"J" Root Name Server Mirrors

Root Servers

A B C D E F G H I **J** K L M

Operator: Verisign, Inc.

[Homepage](#)

Locations

Sites: 75

Amsterdam, NL Ashburn, US Atlanta, US Barcelona, ES Beijing, CN Brasilia, BR
Brussels, BE Bucharest, RO Buenos Aires, AR Cairo, EG Cape Town, ZA Chicago, US
Dakar, SN Dallas, US Denver, US Dhaka, BD Dublin, IE Dulles, US Edinburgh, UK
Frankfurt, DE Fribourg, CH Guam, US Helsinki, FI Hong Kong, HK Honolulu, US Kaunas, LT
Kuala Lumpur, MY Lisbon, PT Ljubljana, SI London, UK Luxembourg City, LU Lyon, FR
Madrid, ES Manila, PH Miami, US Milan, IT Montreal, CA Moscow, RU Mumbai, IN
Nairobi, KE New Castle, US New York, US Oslo, NO Palo Alto, US Paris, FR Perth, AU
Prague, CZ Reykjavik, IS Riga, LV Rome, IT San Jose, CR San Jose, US San Juan, PR
Seattle, US Seoul, KR Singapore, SG Sofia, BG Stockholm, SE Sydney, AU Taipei, TW
Tallinn, EE Tokyo, JP Toronto, CA Turin, IT Vancouver, CA Warsaw, PL Wellington, NZ
Willemstad, CW Zagreb, HR

IPs:

IPv4: 192.58.128.30 IPv6: 2001:503:C27::2:30

So, Here's How It Goes ...

- Your computer's DNS server never heard of `cise.ufl.edu.root` ... so it pulls the domain name apart:
 - `cise`, a computer in the `.ufl` domain
 - `ufl`, a domain in the `.edu` domain
 - `edu`, a domain in the `.root` domain
- So, the DNS begins at the end and starts asking for the numbers of the ANS computers ... who's the ANS for the `.root` domain?

Implied – on all addresses,
so don't bother with it



Your DNS Asks the .root NS

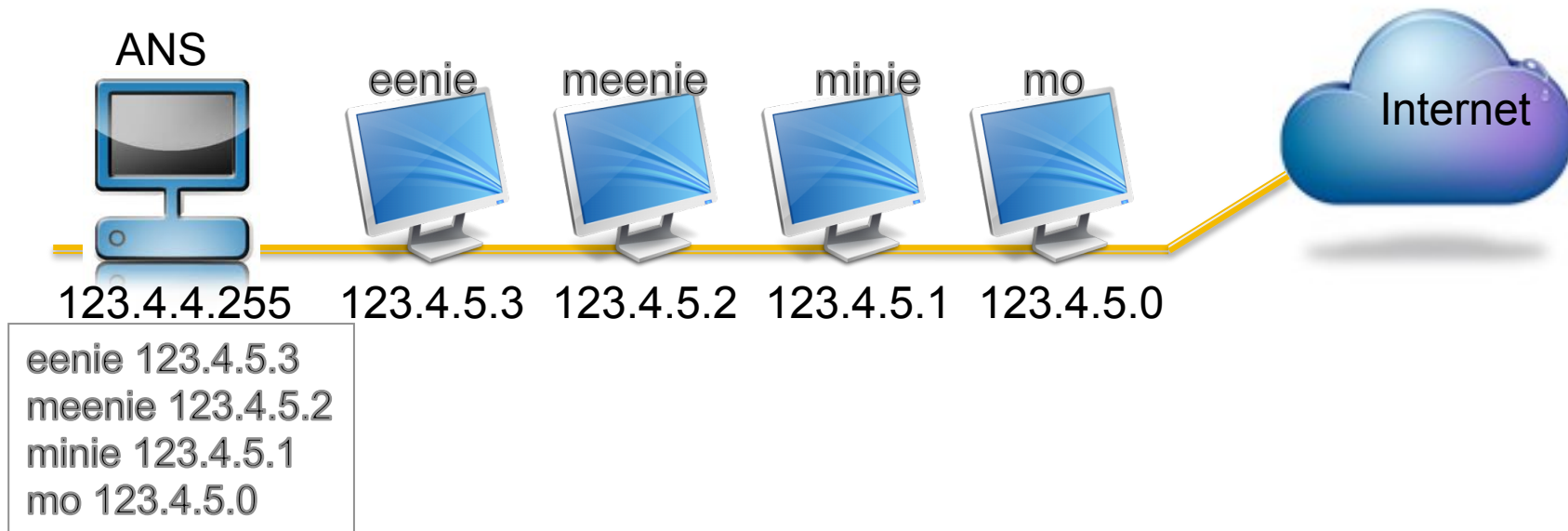
- Please give me the number of .edu ANS
 - Getting that it asks it the .edu autho, ...
- Please give me the number of .ufl ANS
 - Getting that it asks it the .ufl ANS, ...
- Please give me the number of the cise machine
 - Getting 128.227.205.2, it addresses your email and sends it on
- Simplification: it might have cached .edu autho and .ufl autho, which saves those 2 requests

Caching All Lookups

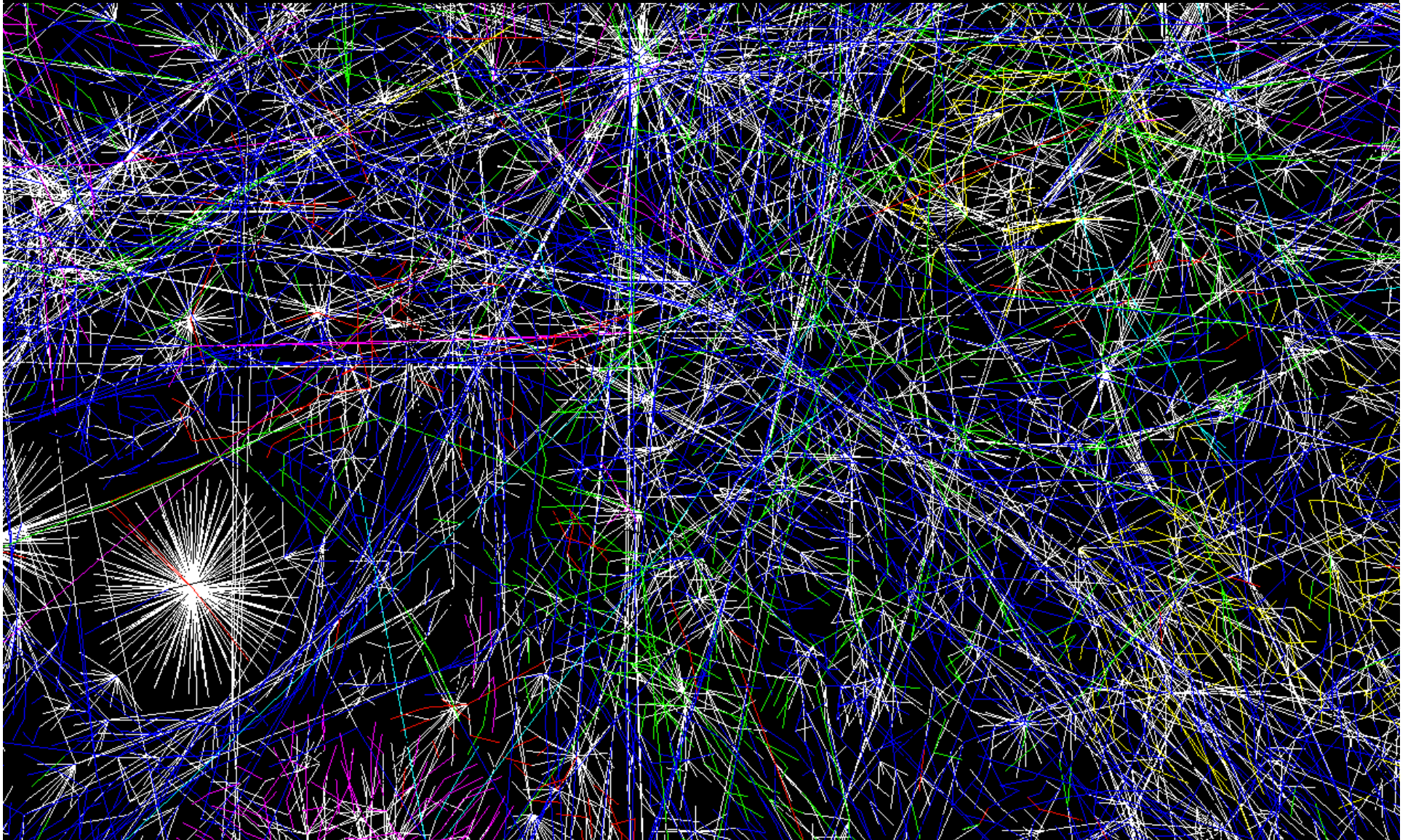
- A cache is a list of previous lookups or previously computed values that are kept on the assumption they will be needed again soon
 - We say the ANS *caches* the addresses it's found
 - *caching* – keeping a copy around in case it's needed again
 - Recall that the first step in a look up is to check the cache ... it may be there, and if so, the lookup is done

Your Friend Helps You Out

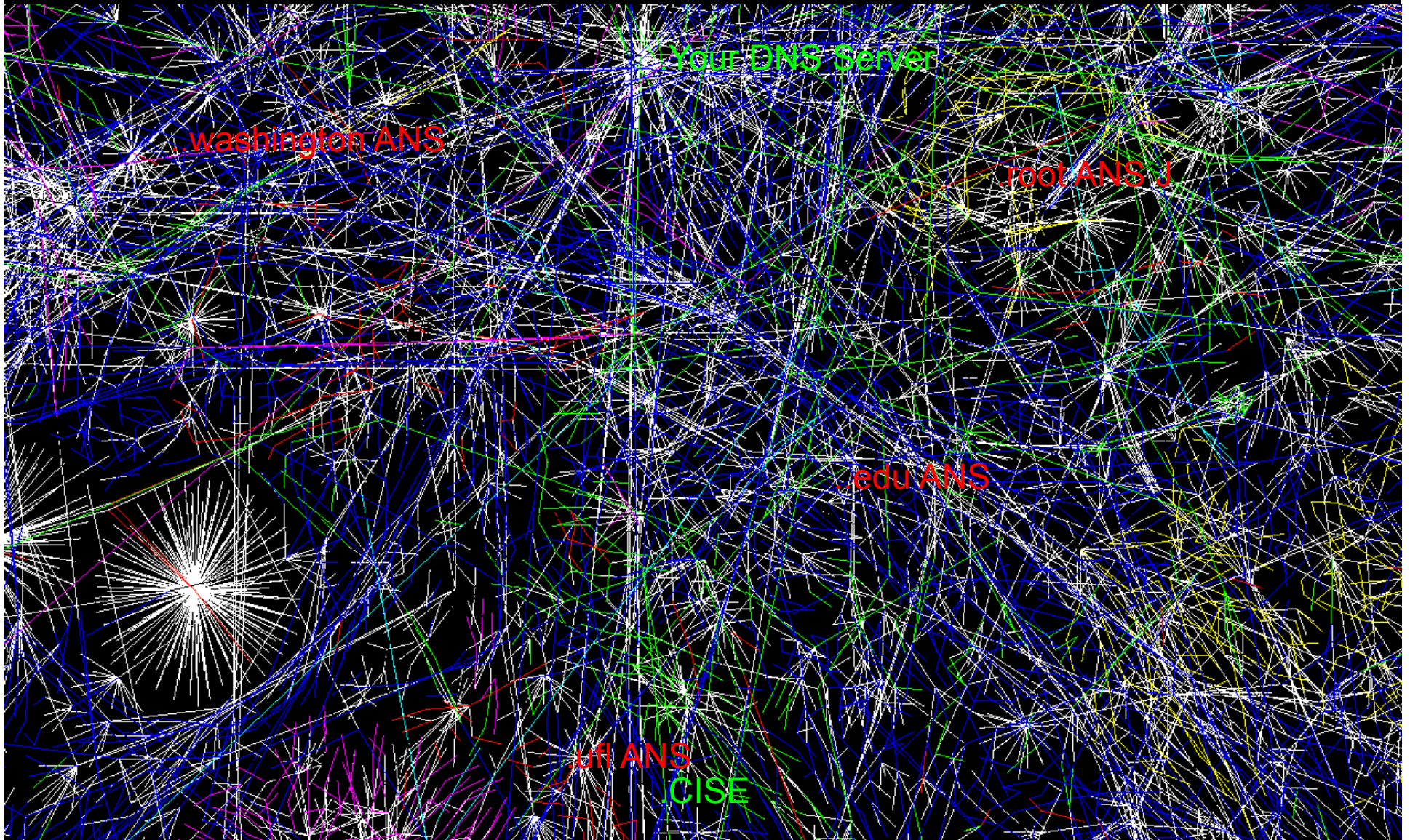
- If your computer is eenie, and your friend is using mo ... his/her earlier mail or visit to cise.ufl.edu helps you ... the IP-address will already be in the cache



Now ... Imagine The ANS Network



Now ... Imagine The ANS Network



Exercise

- To send mail to my friend Alan Fekete, I write fekete@it.usyd.edu.au
- ... What happens next?

The ANS Network

- It's huge – 10's of millions of computers
- It is 100% autonomous – no human involved
... does that make it a robot?
- It is always there – though it is just as error-prone as every other kind of computing
- It provides an amazing service

That's It ... DNS

- What are your questions?
... I'm a teacher of computer science, AMA