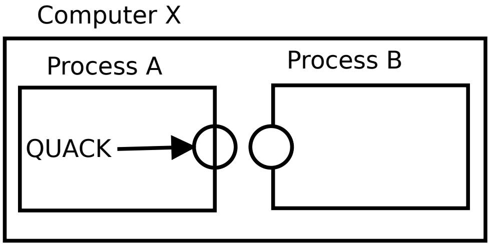
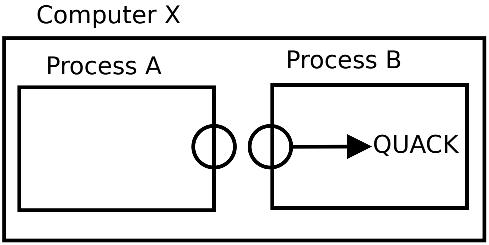
CSSE2310 — 9.2

Networks — Ogres

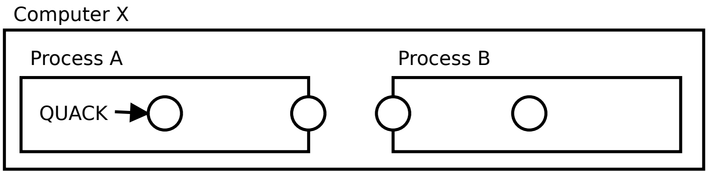
Where are we going?



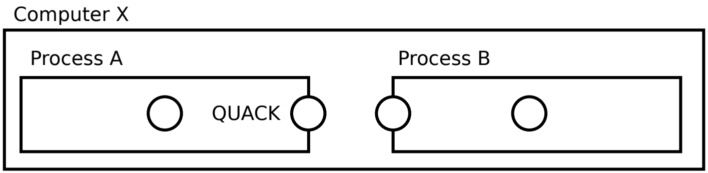
Where are we going?



Where are we going?



Where are we going?



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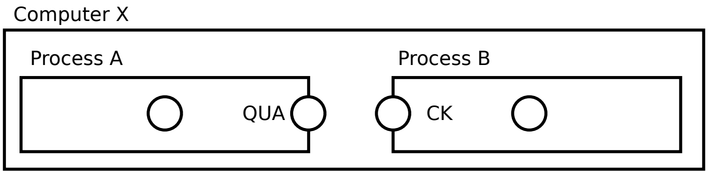
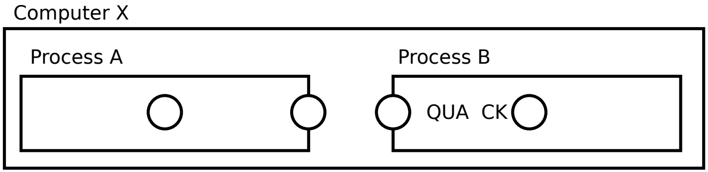


Where are we going?



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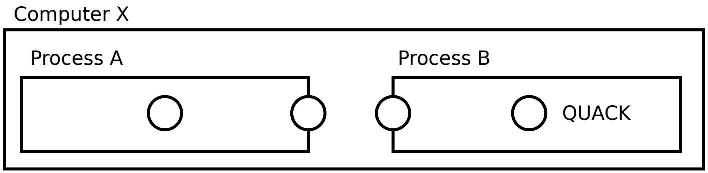

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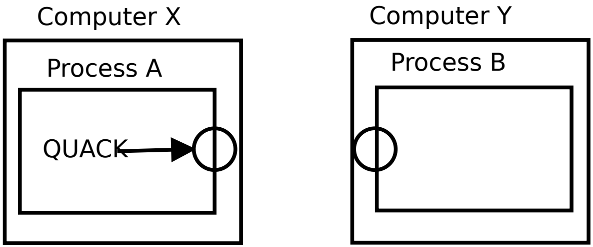
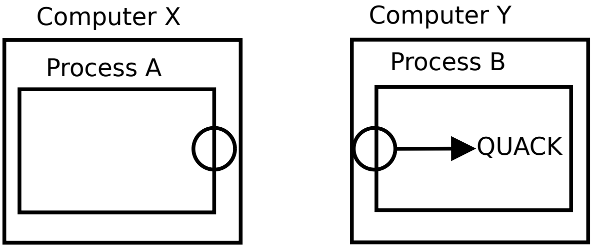


Where are we going?



Software layers

Rather than developing software in one lump, it can be easier (although not always more efficient) to write in layers.

- Make each part of the problem more managable.
- Add capabilities or modes of operation the lower level doesn't allow.
- Hide procedural aspects.
- Make one system act like another system.
- Allow lower levels to be replaced without disrupting the whole system.

A connected set of layers is a “stack”.

C I/O

Standard C I/O is via “streams” (FILE*).

- act as an unstructured sequence of bytes.
- can just keep calling `fgetc()`
  - You might need to wait longer sometimes
- Can ask for numbers or “words” from the stream. (`fscanf()`)

Streams

But we know that bytes from outside need to come from the kernel.

- The kernel doesn't provide that interface.
- Only `read()`/`write()` fixed sized arrays.
  - Which might not process the amount you asked for.
  - Which might be interrupted by signals.
- C standard I/O simulates streams using a hidden buffer and lower level calls.

Devices

Behind the scenes in the kernel. What if the underlying device:

- takes a byte at a time?
- a fixed size block (and nothing smaller) [disk?]
- variable sized chunks [networks?]

Substitution?

Another system suports C standard I/O.
Does it support `read()`?

- Does it matter?

Simple communication stack

1. Communicate with exactly one other entity.
2. Choose which other peer to send a message to get closer to destination.
3. Break a message into parts for commication and reassemble them.

Headers/envelopes

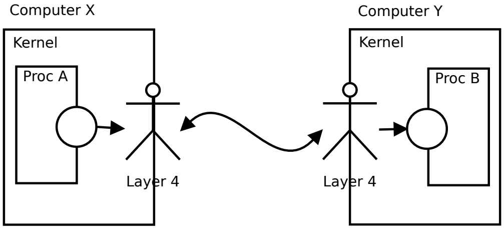
In order to work with lower layers, the "message" may need:

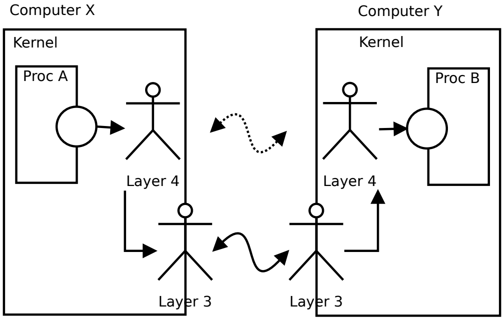
- to be encoded (eg bytes sent via an optical network $\rightarrow$ light pulses)
- Have extra information added
  - Headers (who is message to? from? ...)
  - Footers (ethernet uses both)

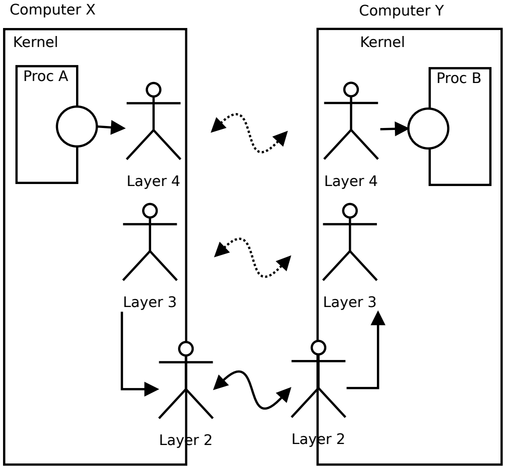
That extra information

- will (usually) be removed at the other end.
- might be the only part of the message that level understands.
  - So we use an envelope as an analogy (you can't see into the envelope)

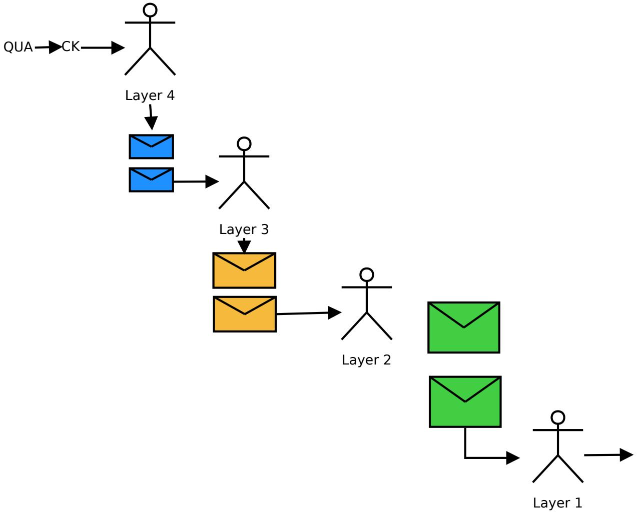
Layers — illustrations

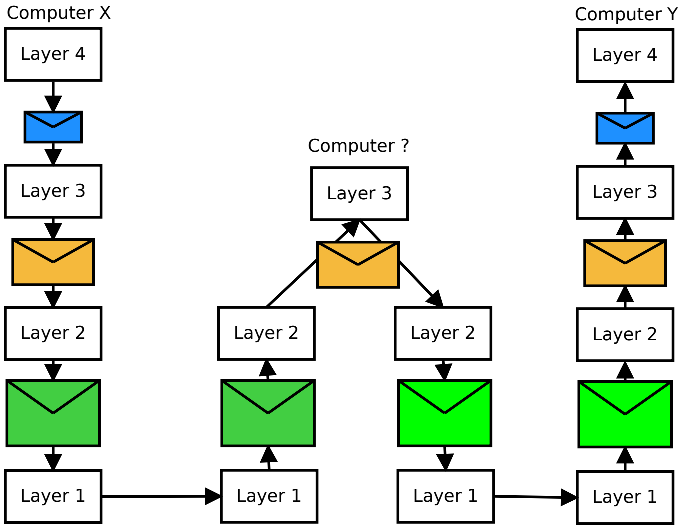

Computer X
Kernel
Proc A
Layer 4
Computer Y
Kernel
Proc B
Layer 4


Computer X
Kernel
Proc A
Layer 4
Layer 3
Computer Y
Kernel
Proc B
Layer 4
Layer 3

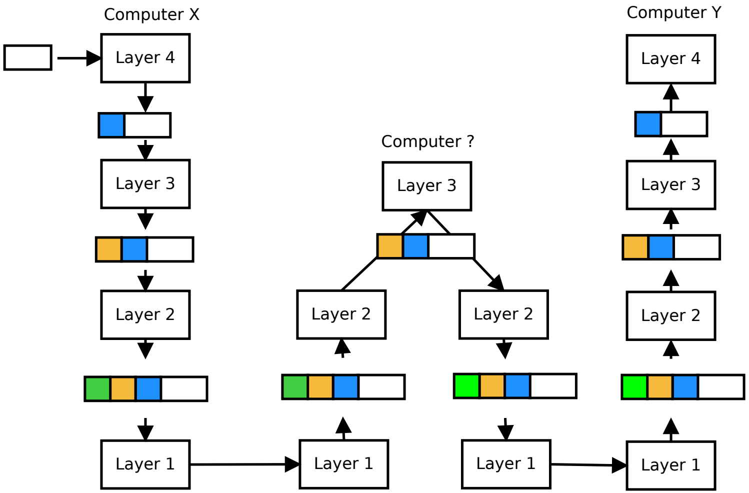

Computer X
Computer Y
Kernel
Kernel
Proc A
Proc B
Layer 4
Layer 4
Layer 3
Layer 3
Layer 2
Layer 2

View 1 — envelopes


QUA
CK
Layer 4
Layer 3
Layer 2
Layer 1


Computer X
Layer 4
Layer 3
Layer 2
Layer 1
Computer ?
Layer 3
Layer 2
Layer 1
Layer 2
Layer 1
Computer Y
Layer 4
Layer 3
Layer 2
Layer 1

View 2 — headers


Computer X
Layer 4
Layer 3
Layer 2
Layer 1
Computer ?
Layer 3
Layer 2
Layer 2
Layer 1
Layer 1
Computer Y
Layer 4
Layer 3
Layer 2
Layer 1