SYST 101: Intro to Systems

Lecture 19

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C. Wells, SEOR Dept.

Announcements cont.

- Central Module lab open most evenings.
  - There are almost always graduate students there.
  - Front door should be open till 9 pm.
  - Course is set up halfway.
  - Arrangements can be made for weekends.
    - But contact me or Ning during the week.

Agenda

- Multiple viewpoints
- System trades

Utility of Lifecycles

- Had they been good systems engineers....

- Consider the full lifecycle of the system, from a variety of viewpoints

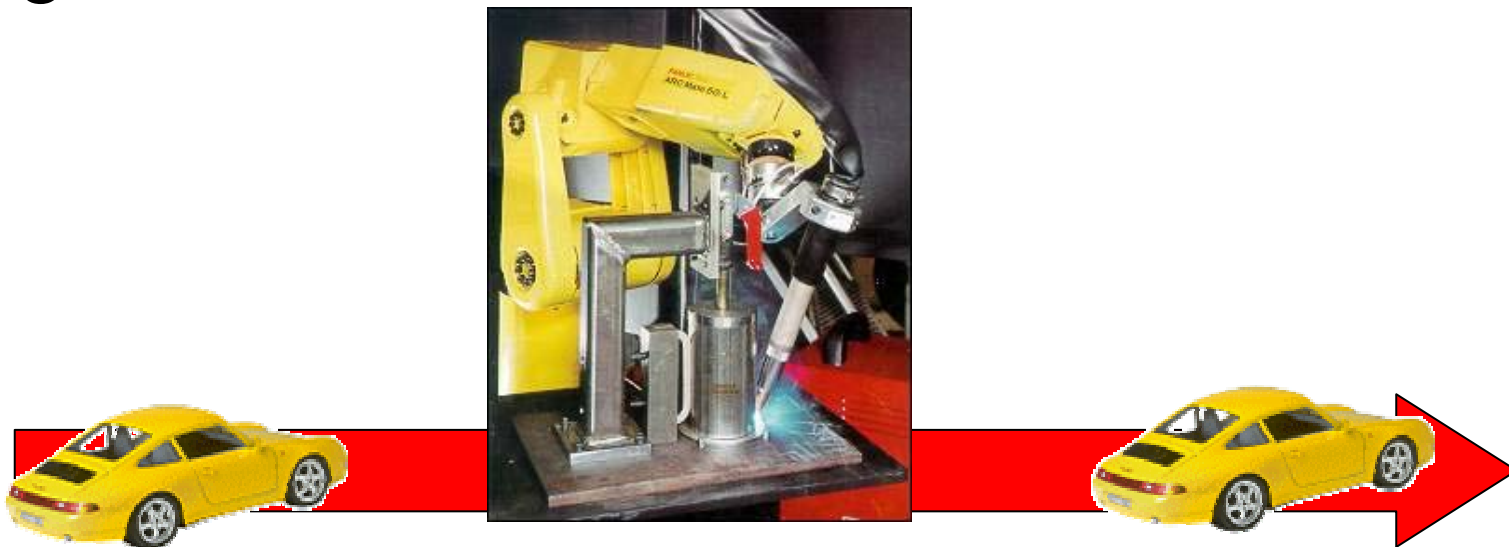- Take the viewpoint of different participants in the system

Example

- An Automobile assembly line

- We can take (at least) 2 views:
  - The assembly station
  - The automobile
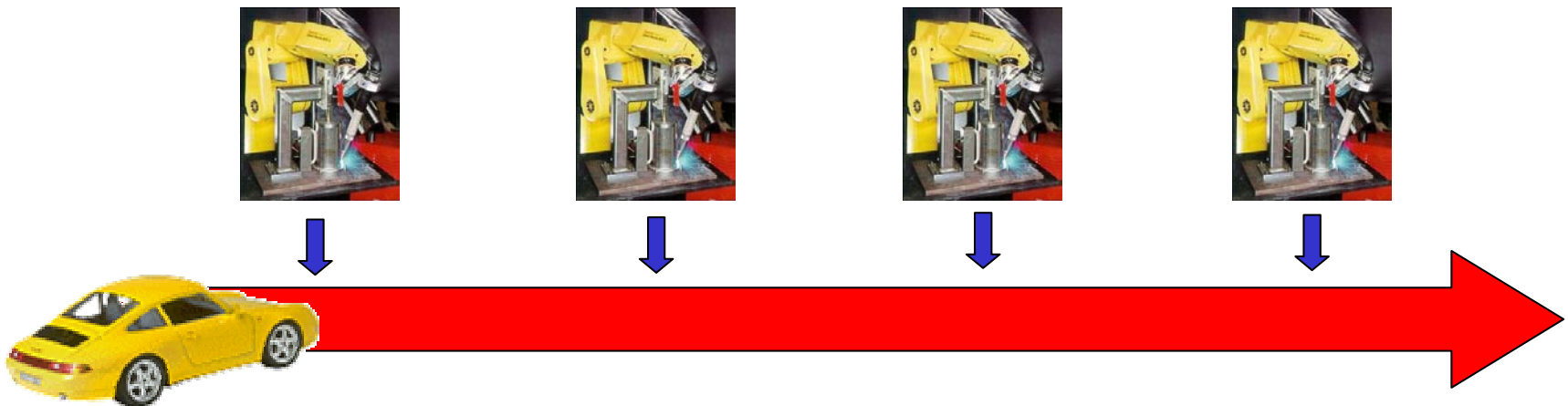
Assembly Station View

- Take the view of the assembly station
- Cars come in, you do your work, cars go out...

Automobile View

- (I am a car)
- I move through a series of stations, each one provides me with one of my parts.

Alternate Views

- Often taken during the system design process

- Helps assure completeness

- In software, often associated with the object-oriented paradigm.

  – "Active" versus "passive" objects

Water & Society

- The trend through history has been to focus on getting water *to* the city, not *away* from it.

- Problems include
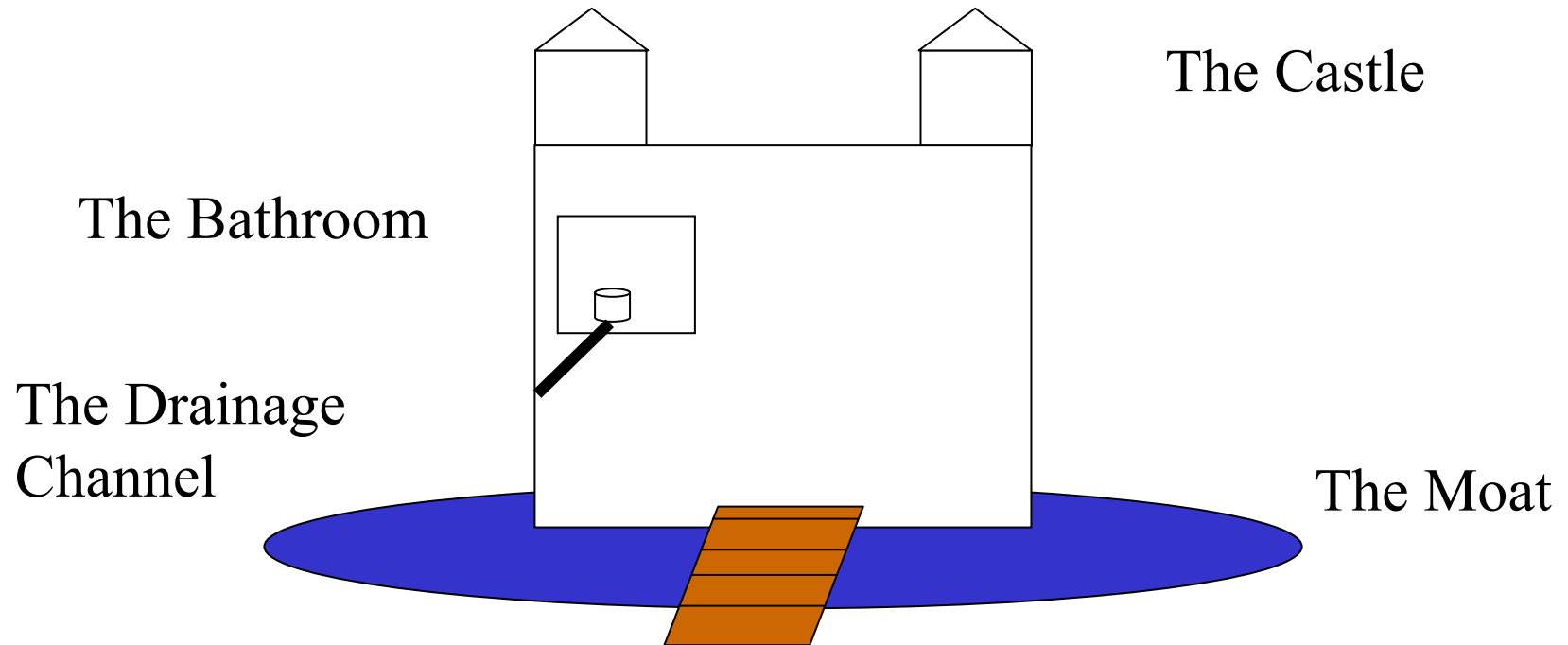 - Bad hygiene, flooding, pollution

Castles of the Middle Ages

- Castles of Europe often were surrounded by moats

- Classic drawbridge provided security

- But the moat served a crucial everyday purpose

Bathrooms in the Castles

- Cross sectional view...

The Castle

The Bathroom

The Drainage
Channel

The Moat

Operational Concept

- Bring buckets of water up to bathroom.
- After bathroom use, pour water down toilet.
- Sewage washed down channel, drools down outside wall.
- Rain washes walls off into moat.
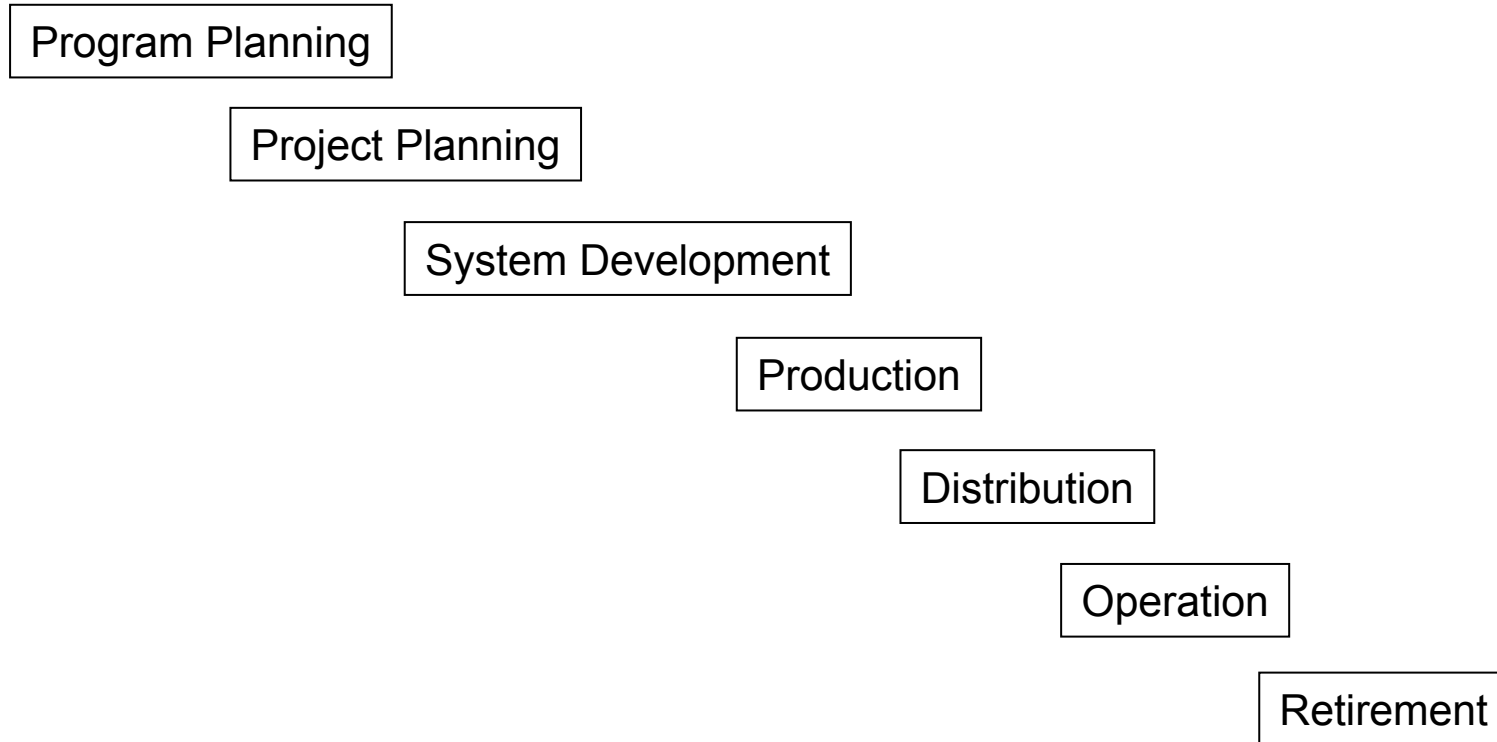- Water flow through moat prevents stagnation and unpleasant odors.

Roman Aqueducts

- The Romans spend an amazing amount of time and effort to get water _to_ Rome

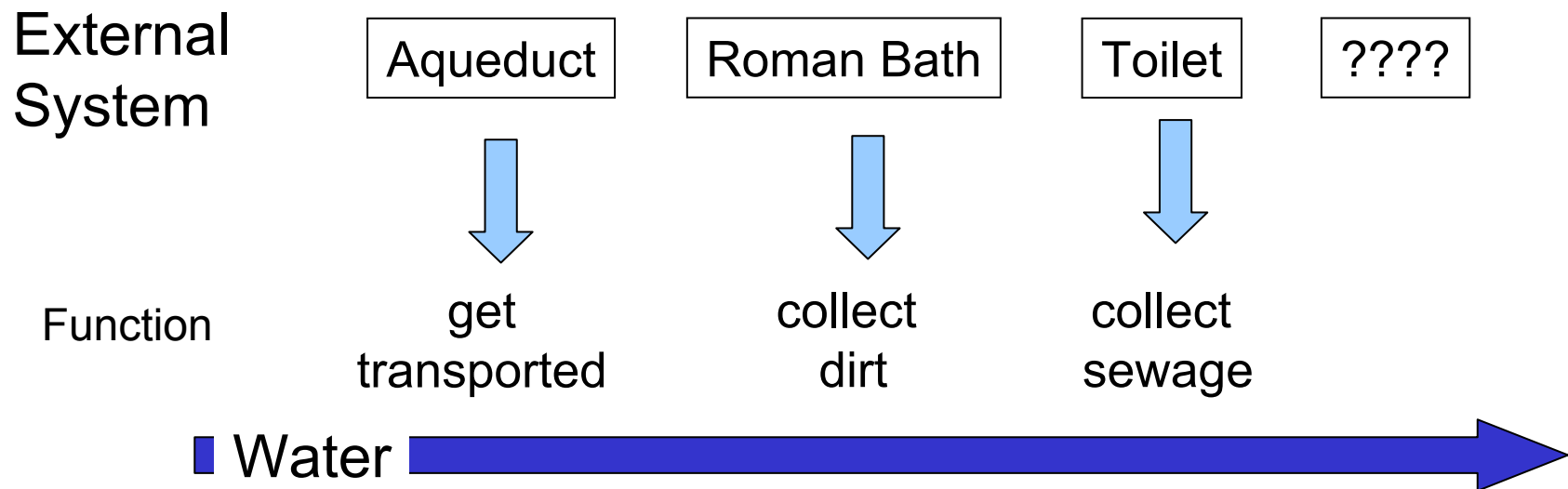- Very little effort in getting wastewater _away from_ Rome....

The Waterfall Process

Program Planning

Project Planning

System Development

Production

Distribution

Operation

Retirement

Example Re-Visited

- Examine the cycle from the *water's* point of view

External
System

| Aqueduct | Roman Bath | Toilet | ???? |

Function

get
transported

collect
dirt

collect
sewage

Water ⟶

- So, where does the water go after that?

Retirement Phase

- Same goes for hazardous materials, such as solvents, fuels, etc.

- Even if you're engineering the engine, someone on the team should take the viewpoint of the various solvents, fuels, lubricants, and consider their lifecycles as well.

Personal Computers

- They contain lots of different pollutants, which cause serious problems when they enter the environment
  - Lead, silver, mercury.
  - PCBs and diphenyls when wire & insulation are burned.

PC Disposal

- Where do obsolete personal computers go?
  - To companies that scrap them

- Where are these companies?
  - Currently, mainly in countries that do not have environmental protection laws, thus allowing them to operate much cheaper (and dirtier)
    - Causing significant pollution in those areas

- Most European countries prohibit the shipping of salvage PCs out to such companies -- the United States does not (yet)
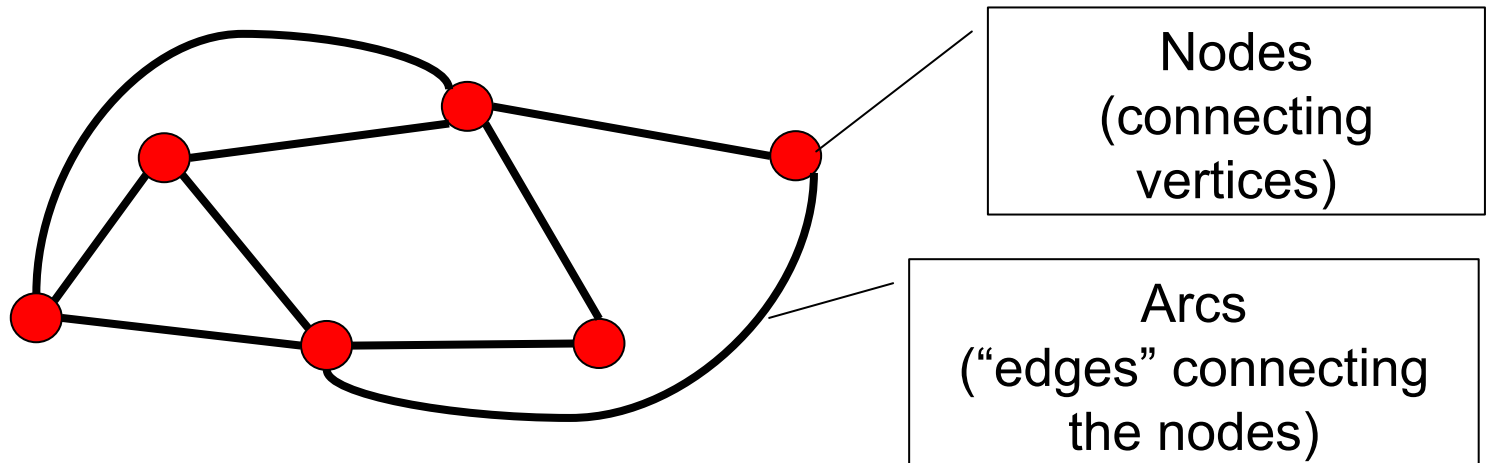
Consider the Retirement Phase

- Nuclear Power Plant Waste

- Building Dams on Rivers

- Spacecraft & Satellites
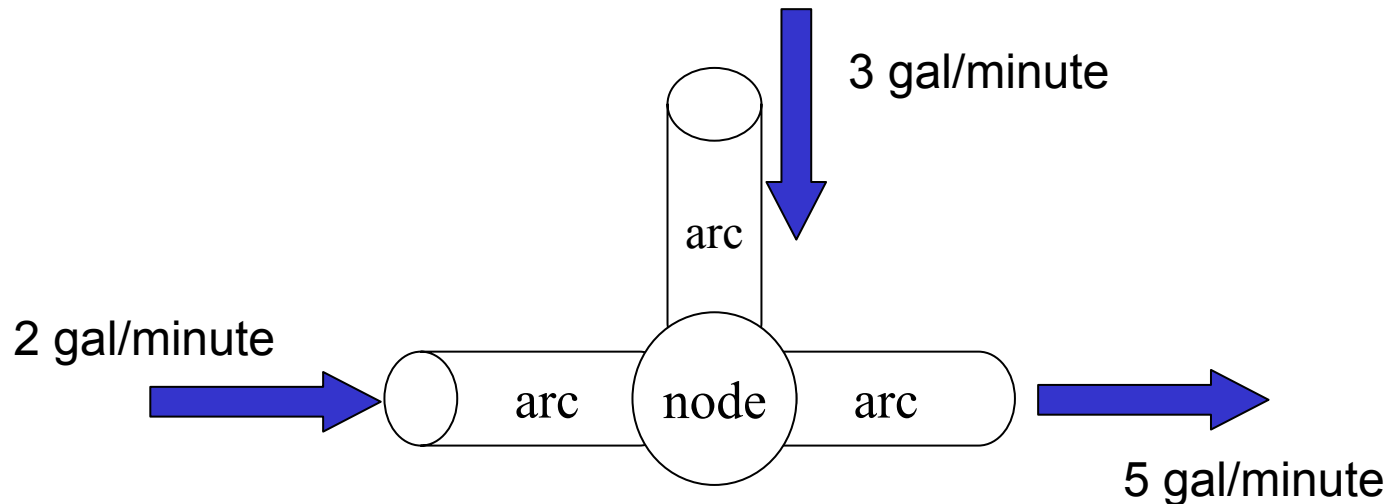
Network Calculations

- A set of water supply or sewage pipes in a city can be considered a network

- (Almost) any combination of nodes and arcs can be considered a network

Nodes
(connecting
vertices)

Arcs
("edges" connecting
the nodes)

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"What Goes In, Must Come Out"

- In electrical engineering, it's known as Kirchoff's Current Law:
  - The sum of the flows entering a node must be equal to the sum of the flows exiting the node.

3 gal/minute

arc

2 gal/minute

arc   node   arc

5 gal/minute

Network Flow Calculations

- Now can be expressed as sets of related equations, and solved using the "Solver" add-in in Excel

- Linear Equations/Matrix Algebra - MATH 203

- SYST 201, 202, 302 - modeling and optimization

Assignments

- Reading
  - Petroski, Engineer is Human Chapters 9
    - "Safety in Numbers"

- Homework
  - none