16.070

Introduction to Computers & Programming

http://web.mit.edu/16.070/www/

Prof. I. Kristina Lundqvist
Dept. of Aero/Astro, MIT

Today

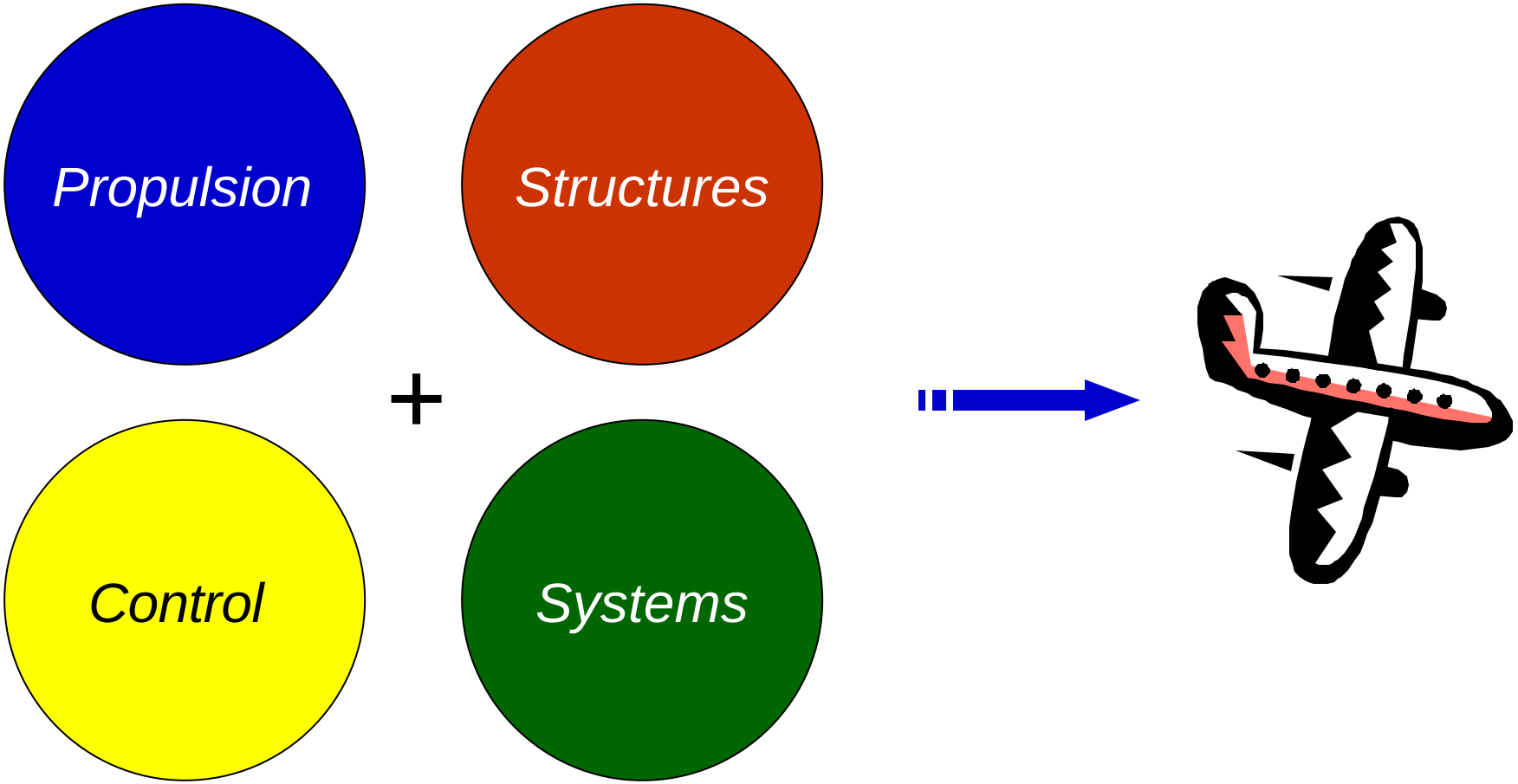
- Introductions
- Why?
  - 16.070 as part of the Aero/Astro core curriculum
- How?
  - Programmatics
  - Administrativa
- What?
  - Course objectives

Introductions

- Instructor (33-332 , kristina@mit.edu)
  - Prof. I. Kristina Lundqvist
- Graduate TA (33-106, jksrini@mit.edu)
  - Jayakanth “JK” Srinivasan
- Undergraduate TAs (33-106)
  - Gerardo Guevara
  - Nayden Kambouchev
  - Malia Kilpinen
  - Robin Riedel

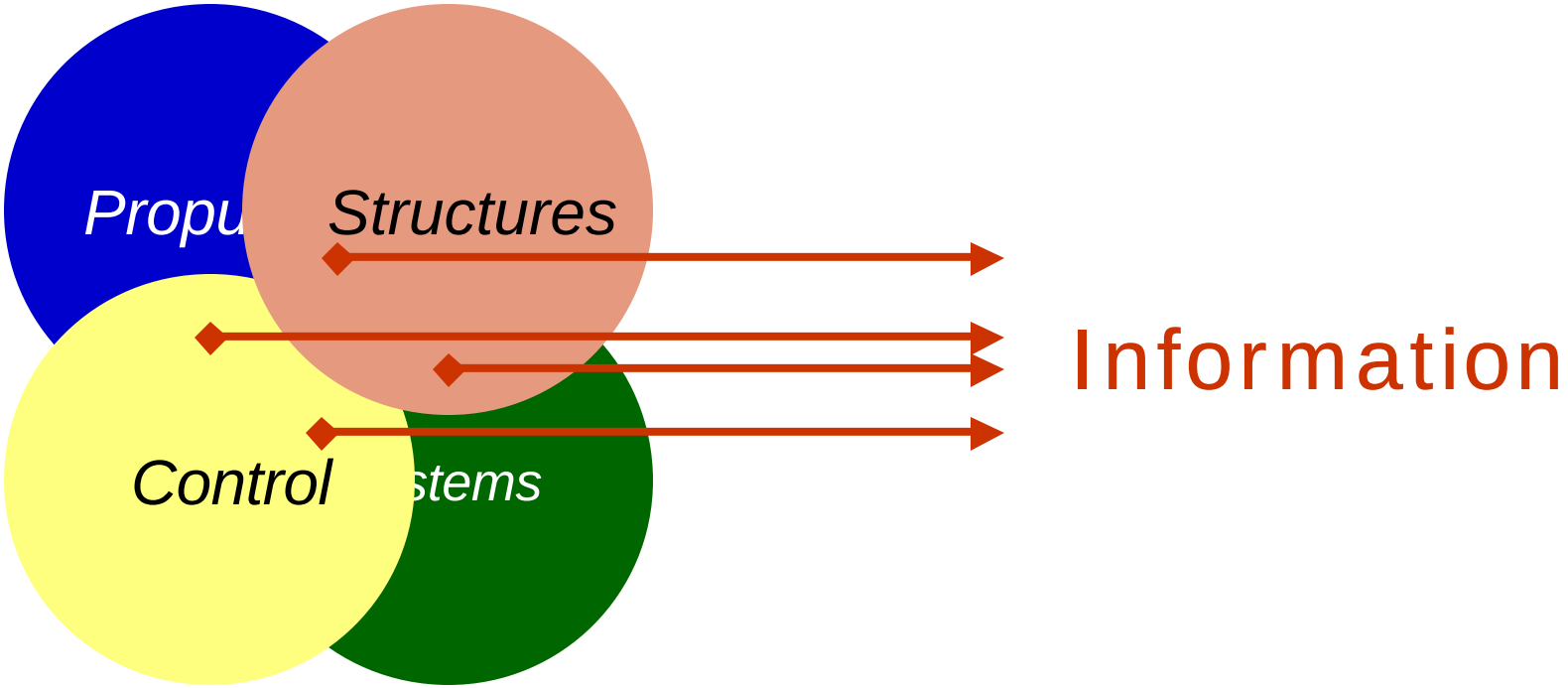
Catherine Chang
Mabel Feng
Chinwe Nyenke
Darlene Utter

16.070 as part of Aero / Astro Core Curriculum



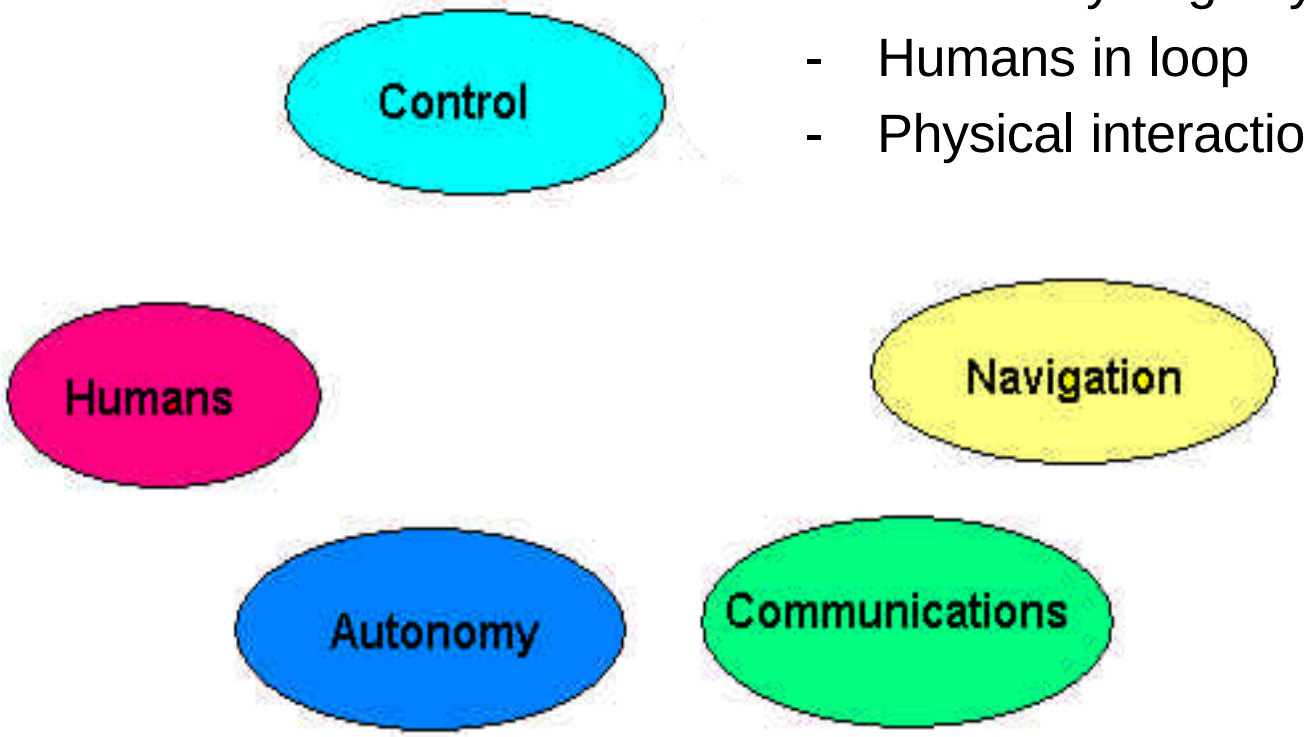
16.070 as part of Aero / Astro Core Curriculum

Integrated design process



Aerospace Info Systems

- Real time
- Criticality
- Extremely large systems
- Humans in loop
- Physical interactions



A Typical Flight

▪ Make a reservation		15,000,000	LOC
▪ Board aircraft		5,000,000	LOC
▪ Airlines planning/Maintenance		20,000,000	LOC
▪ Air traffic control		30,000,000	LOC
▪ Weather data		10,000,000	LOC
▪ Navigation network		10,000,000	LOC
▪ Communication network	+	10,000,000	LOC
		100,000,000	LOC

Software is vital even in moving mass

One Strike and you are Out

Polar Lander Leading Diagnosis:

- Legs deployed during descent.
- Noise spike on leg sensors latched by software monitors.
- Laser altimeter registers 50ft.
- Begins polling leg monitors to determine touch down.
- Latched noise spike read as touchdown.
- Engine shutdown at ~50ft.

Summary

- Modern Aerospace Systems range from information intensive to information centric
- Increasing fraction of new functionality & performance comes from information/software
- Increasing fraction of development effort/cost in information/software
- Increasing fraction of failures comes from information/software
- The system “integrator” usually comes from the sub-system that dominates cost & performance

Needs

- Society needs engineers who can:
  - Conceive
  - Design
  - Implement
  - Operate

  Integrated Mechanical-Electrical-Information System
- You need the knowledge, skills & attitude to do this

How? Programmatics

- Texts and Handouts
- Broad spectrum of student experience
- Topics covered
  - Ada programming
  - Computer architecture
  - Algorithm analysis
  - Software development
  - Theoretical computer science
- Final projects

How? Expectations

- Students responsible for all material covered in lectures, recitations, labs, handouts (done ahead of lecture)
- Homework is 40% of your grade – do it, and hand it in on time!
  - Pset posted on Web on Wednesdays, due following Wednesday lecture
  - Computers available: 33-202, inside/outside Aero Library, home
  - Late assignments
    - Approval from Prof. Lundqvist/JK prior to due date
    - No more than 2 days (i.e., until Friday) delay will ever be approved
    - W/o approval, docked 1/3 of grade for each 24 hour late

How? Expectations

- Collaboration/teamwork policy on the web
- Pathways for feedback
  - "Muddiest Point" anonymous on the web
  - Concerns: Prof. Lundqvist, TA (grad or undergrad), advisor, Prof. Deyst

What? Administrativa

- Schedule of lectures, recitation, labs, office hours
- Scheduling "Tuesday"
  - *8 sessions available, max 10 students per session*
  - Lab times
    - M3, M4, T9, T12, T1, T2, T3, T4
- Go to web page and identify conflicts that you have with the lab times
  - Pset 1: 2 problems: Due Friday, 2/7/02 by 6pm
  - Announcements link
- Lab times will be assigned and students notified by email no later than Monday

Course Schedule

16.070

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9 AM			Robin, Nayden				
10							
11			Office Hours Malia				
12 PM			Lab Gerry, Nayden				
1		Office Hours Malia	Lab Gerry, Robin	Office Hours Gerry		Office Hours Robin	
2		Lecture	Lab Darlene Catherine	Lecture	Recitation	Lecture	
3		Lab Robin, Malia	Lab ??	Office Hours Prof. Lundqvist	Office Hours JK		
4		Lab Robin, Malia	Lab ??	Weekly mtg	Office Hours JK		
5		Office Hours Mable	Office Hours JK				
6		Office Hours Nayden	Office Hours JK				
7	Office Hours Nayden		Office Hours Malia				
8			Office Hours Malia				
9			Office Hours Nayden				
10			Office Hours Gerry				
11			Office Hours Gerry				
12			Office Hours Gerry				
1							

Meeting
Lecture
Lab
Recitation
Office Hours

What? Course Objectives

- After attending 16.070 the student will have an understanding of the fundamentals of computer science and will have learnt problem solving using the Ada 95 programming language.
- Measurable outcomes:
  - To be able to *solve simple problems in computer science* with a specific focus on digital logic, number systems, proof theory, and algorithm analysis (problem sets, quizzes).
  - To be able to solve *basic programming* problems (programming assignments, quizzes).

What? Course Objectives

- Measurable outcomes:
  - To get an intuitive understanding of the *process of programming*: Problem understanding, formulation, solution, and implementation cycle (programming assignments, final project, quizzes).
  - To be able to translate intuitive understanding to practical *implementation* using good design practices and software tools (Programming assignments, Final Project).
  - To develop a programming style that is accepted *industry practice* (Programming assignments, Final Project).
  - To understand the *impact of computer science on aerospace* (Final Project).

Software

- Operating systems
- Concept of a process
- Programming language history
- Software engineering
  - Software life cycle
  - Modularity
  - Design methodologies

Ada 95

- Programming experience
- Algorithms
  - Search and sort
  - Recursion
  - Algorithm analysis: *What makes some problems computationally hard and others easy?*
- Data structures
  - Arrays, linked lists, stacks, queues, trees, graphs, hash tables, …

Use of Ada Around the World

- The control software of nearly every new commercial aircraft model, including the Boeing 777, the Airbus 340, and many regional airlines
- Nearly every country's air traffic control system
- High-speed railroads, including French TGV, and the French/British Channel Tunnel system
- A number of communications and navigational satellites and ground-based equipment
- Steel mills, industrial robotics, medical electronics, telecommunications, …

Computer Architecture

- Data storage
- Memory organization
- Binary system
- Data compression
- Different computer architectures
- Machine language
- Program execution

Theory of Computation
Automata, Computability, and Complexity

- *What are the fundamental capabilities and limitations of computers?*
  - Finite State Machines (FSM)
  - Regular languages, DFA, NFA, CFG, PDA, Turing machines, halting problem, P/NP hard problems
  - Proof theory

- Tomorrow: **Programming mechanics**: how to use the PC computers, brief intro to compiler, tools, Source code, executable, libraries, simple I/O, and web page basics (JK @ 35-225)

- Friday: **Machine architecture:** Data storage, logic gates, flip-flops, memory organization, mass storage, representing numbers, text as bit patterns