

Recap of Last Class

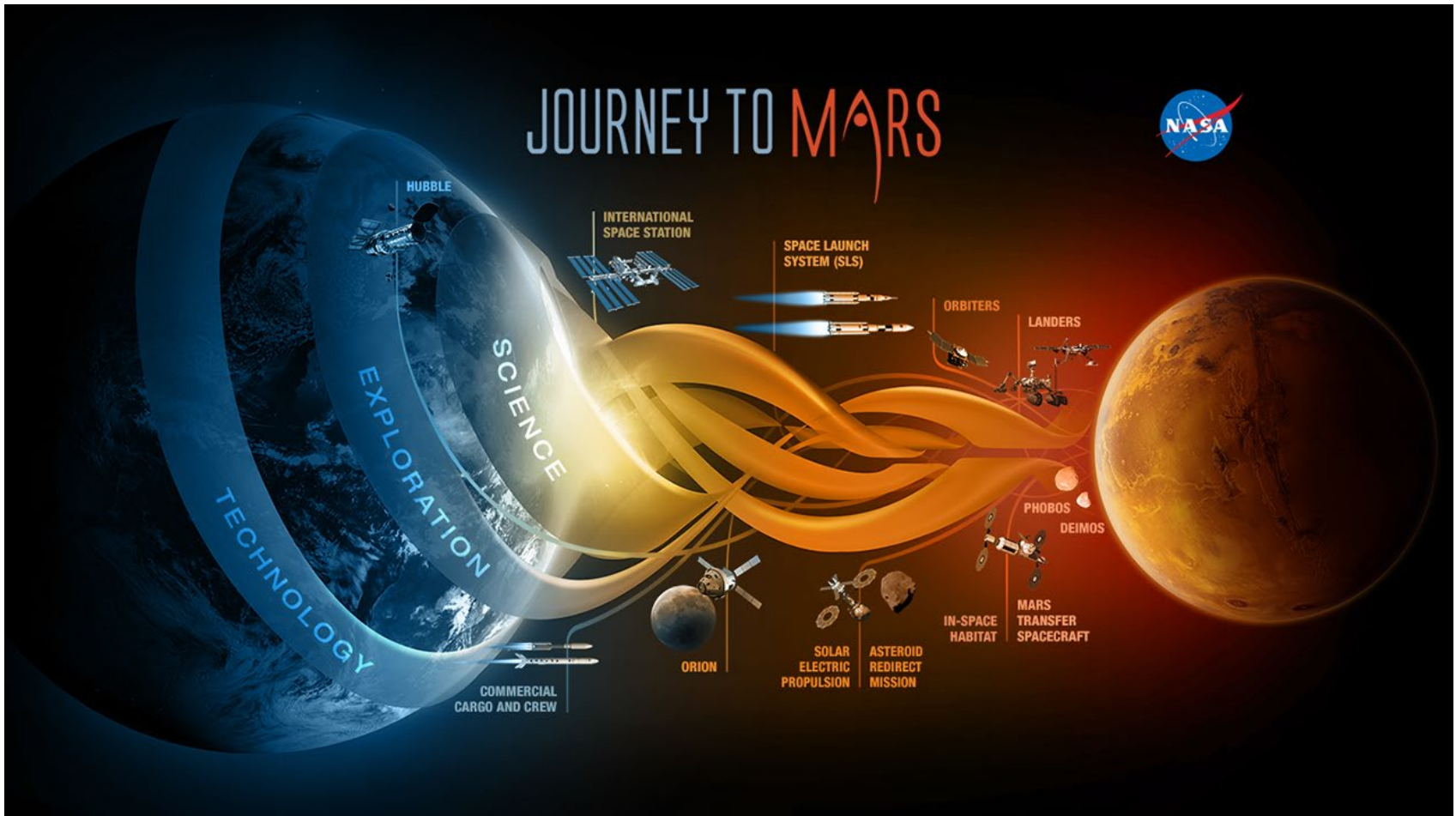
- Characteristics of embedded systems
 - Real-time, low power, performance constraints
- Why use a microprocessor
 - Alternatives: ASIC, microprocessor, FPGA
 - Microprocessor: reprogramability, performance/power ratio

ECE 175
Embedded Systems Design
Design Methodology II

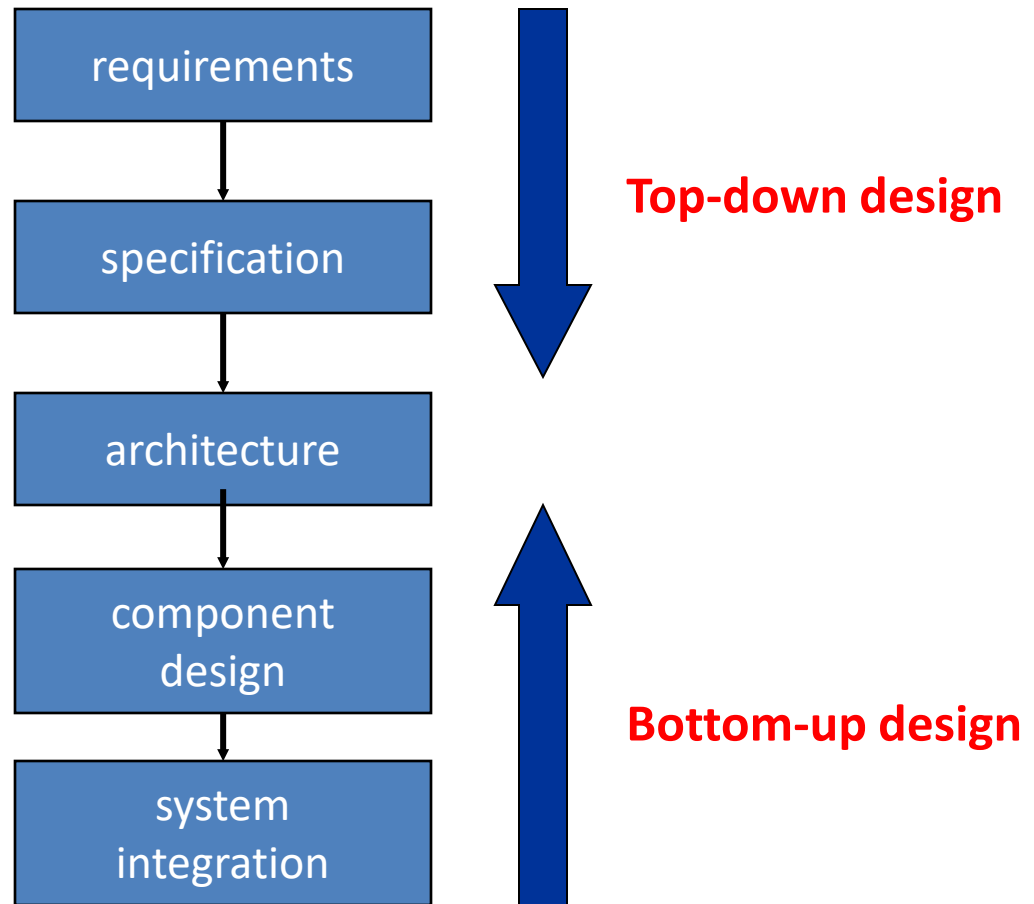
Wei Gao

How to fly to Mars?

- NASA's journey to Mars



Design Methodologies



Requirements

- Plain language description of what the user wants and expects to get.
- May be developed in several ways:
 - Talking directly to customers;
 - Providing prototypes to users for comment.
- Functional vs. non-functional requirements
 - Functional: output as a function of input
 - Non-functional: timing constraints, power consumption, size, weight, etc.

Requirements Form

name

purpose

inputs

outputs

functions

performance

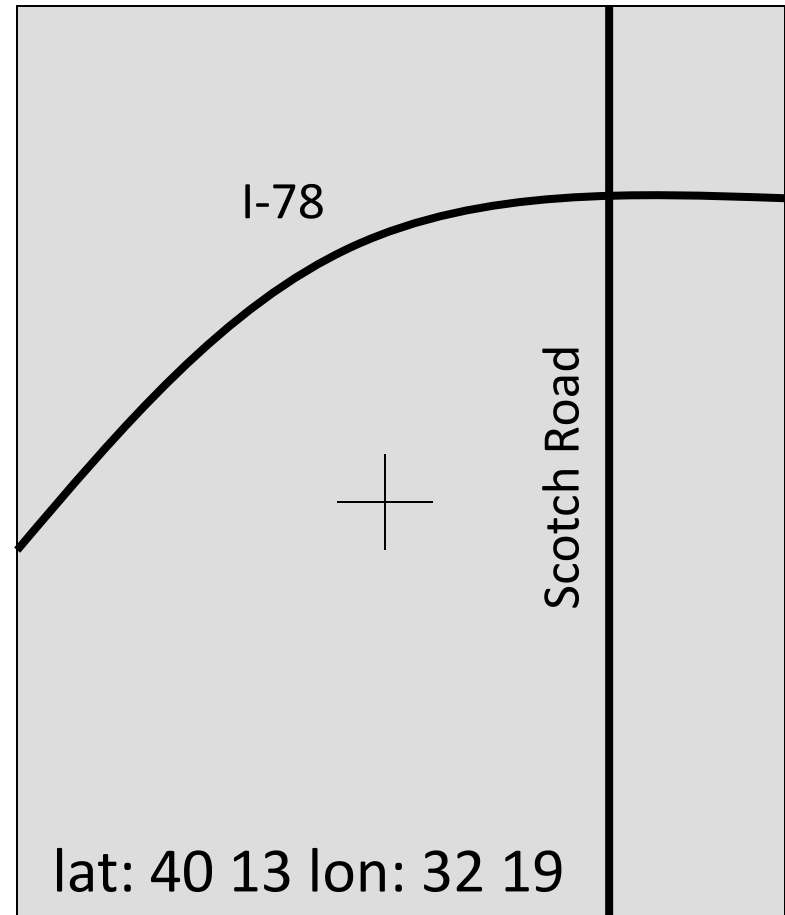
manufacturing cost

power

physical size/weight

Example: GPS Moving Map Requirements

- **Purpose:** Obtains position from GPS, paints map from local database.



GPS Moving Map Requirements

■ Functionality

- For car driving use, not for airplanes or boats
- Show major roads and landmarks.

■ User interface

- At least 400 x 600 pixel screen.
- Three buttons max.
- Pop-up menu.

■ Performance

- No more than 1 sec power-up.
- Lock onto GPS within 15 seconds.
- Update location every 0.25 sec.

GPS Moving Map Requirements

- **Cost:** street price no more than \$100
- **Physical size/weight:** Should fit in hand.
- **Power consumption:** Should run for at least 8 hours on four AA batteries.

GPS Map Requirements From

name	GPS moving map
purpose	consumer-grade moving map for driving
inputs	power button, two control buttons
outputs	back-lit LCD 400 X 600
functions	5-receiver GPS; three resolutions; displays current lat/lon
performance	updates screen within 0.25 sec of movement
manufacturing cost	\$100 cost-of-goods- sold
power	100 mW
physical size/weight	no more than 2: X 6:, 12 oz.

Specification

- More precise description of the system:
 - should not imply a particular architecture;
 - provides input to the architecture design process.
- May include functional and non-functional elements.
- UML: Unified Modeling Language
 - Not required in this course

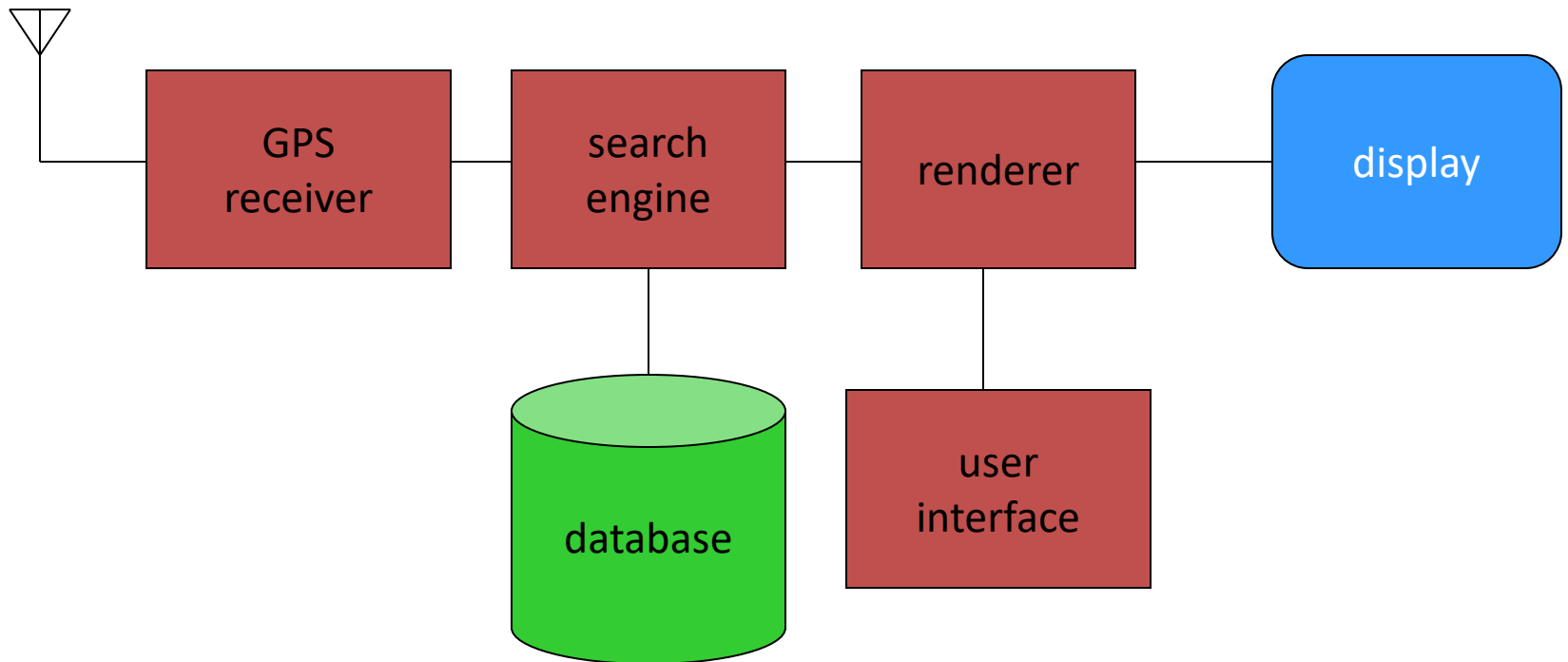
GPS Specification

- Should include:
 - what is received from GPS;
 - map data, format;
 - user interface, menu items;
 - operations required to satisfy user requests;
 - background operations needed to keep the system running
 - Event-driven or periodic?.

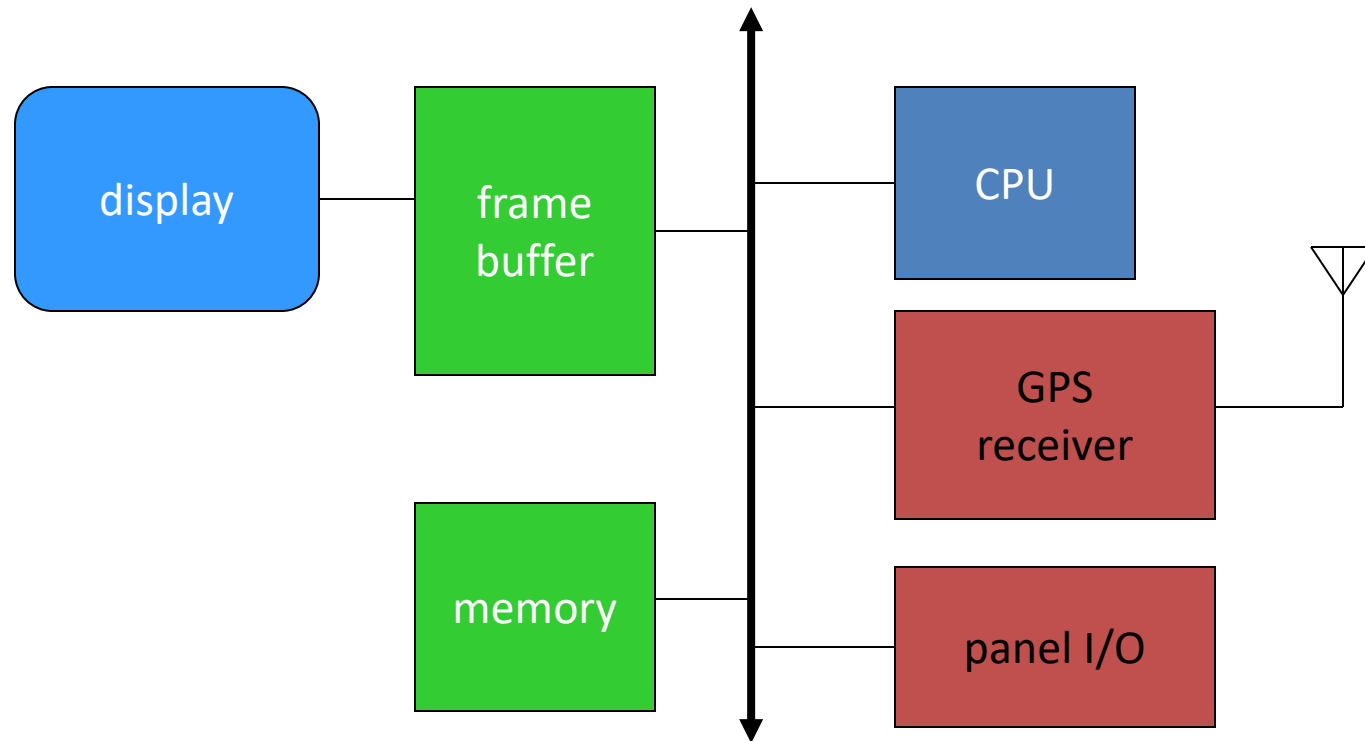
Architecture Design

- What major components can satisfy the specifications?
- Hardware components:
 - CPUs, memory, GPS receiver, etc.
- Software components:
 - Topographical database, access functions, etc.
- Must take into account functional and non-functional specifications.

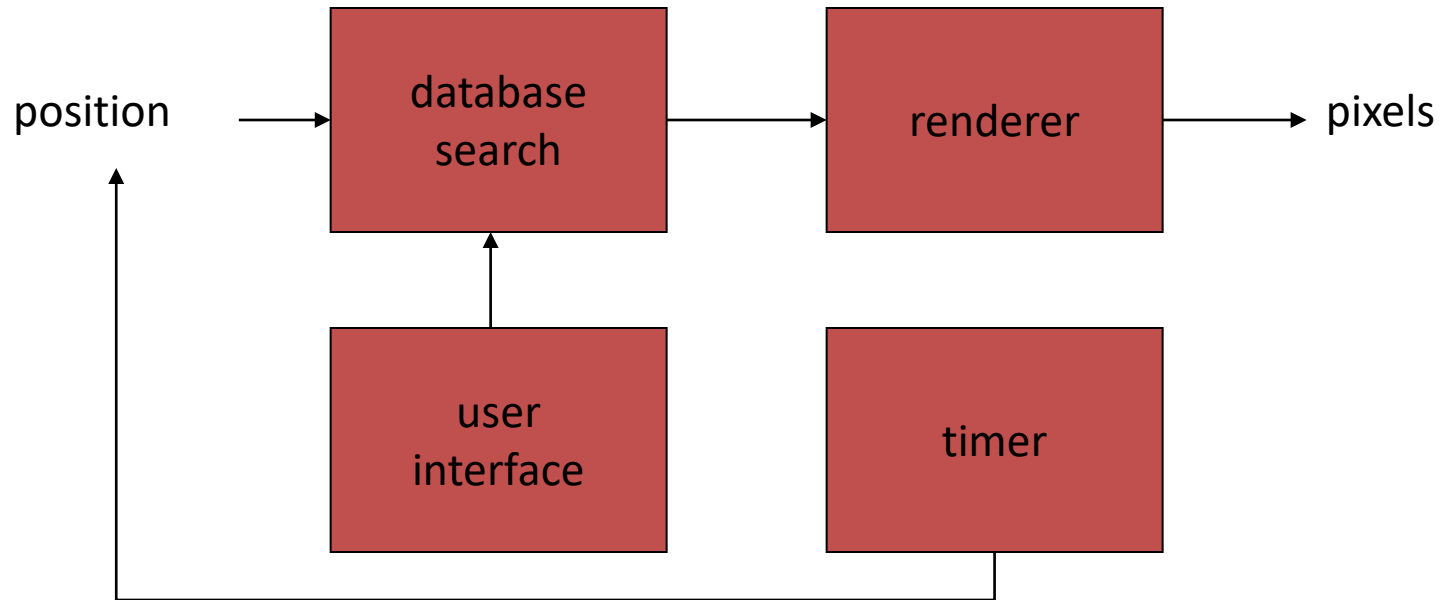
GPS Moving Map Block Diagram



GPS Moving Map Hardware Architecture



GPS Moving Map Software Architecture



Designing Hardware and Software Components

- Must spend time architecting the system before you start coding.
- Components maybe
 - ready-made
 - modified from existing designs
 - designed from scratch
- Components in an embedded system will be covered in following classes

System Integration

- Put together the components.
 - **Many** bugs appear only at this stage.
 - Individual components should be tested first!

Summary

- Characteristics of embedded systems
 - Non-functional requirements: real-time, low-power, low-cost
- Why do we use microprocessors today?
- Embedded systems pose many design challenges:
 - Design time
 - Deadlines
 - Power
 - Cost
 - ...
- Design methodologies help us manage the design process.
 - Top-down vs. bottom-up

Homework Assignment 1

- On design methodology
- 3% of your final grade
 - Individual work, no collaboration is allowed
- One-week turnaround time
 - Due on 1/26 before class
 - Submit your work on Canvas as a separate file