CS/EE/ME 75a
System Specs and GOTChA Charts

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Meeting Goals and Agenda

Goals

- Introduce (draft) specifications for Urban Challenge
- Introduce GOTChA charts
- Provide overview of how Alice currently works

Agenda

12:00 Goals, Agenda, Notetaker

12:05 System Specification

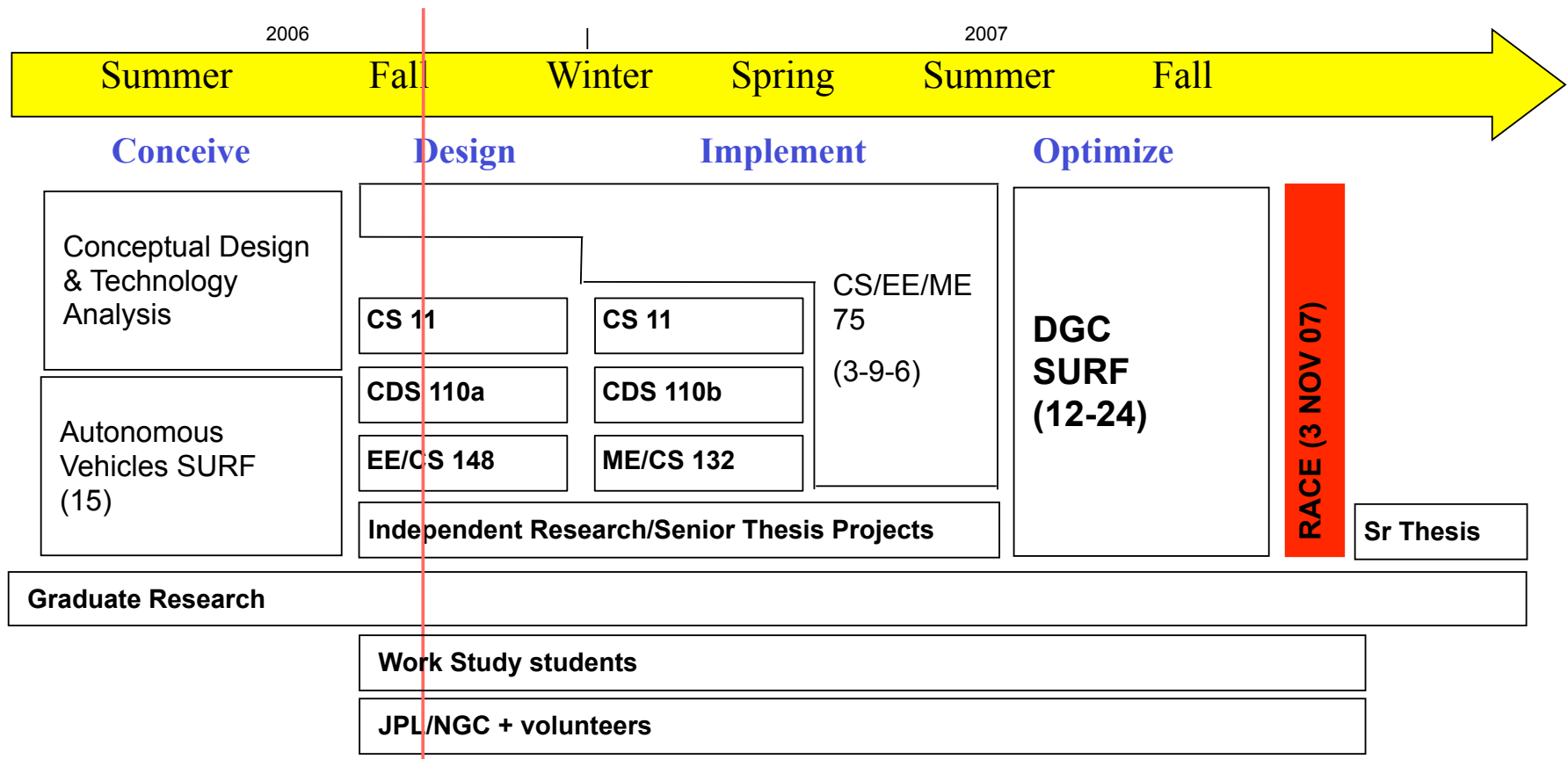12:20 GOTChA charts

12:35 Intro to Alice

12:55 Adjourn

Notetaker: _____

- Record notes and action items from meeting; post on wiki

Team Caltech, 2006-07

Goal: design, build and document an autonomous ground vehicle that can win the 2007 Urban Challenge

2006				2007	
Summer	Fall	Winter	Spring	Summer	Fall

Conceive   **Design**   **Implement**   **Optimize**

Conceptual Design & Technology Analysis				
	CS 11	CS 11	CS/EE/ME 75 (3-9-6)	DGC SURF (12-24)
	CDS 110a	CDS 110b		
Autonomous Vehicles SURF (15)	EE/CS 148	ME/CS 132		
	Independent Research/Senior Thesis Projects			Sr Thesis

RACE (3 NOV 07)

Graduate Research

Work Study students

JPL/NGC + volunteers

System Specification (from Wiki)

1. Vehicle characteristics
- 14 hr running time (power, cooling, fuel) at up to 30 mph
- 15 m/s max speed in dry conditions, with all sensors functional (tolerable blur) on pavement or dirt
- Able to come to a full stop within 4 s in dry or wet conditions
- Able to operate in 40 degC for 6 hours and light rain for 2 hours without damage to electronics

2. Driving on urban roads
- Detect and drive within 3.5 m wide lane with no dGPS information, within 1 m/s at up to 15 m/s
- Detect fixed obstacles (1 m high, 0.5 m wide) in front of vehicle at 30 m [derived from 1] and stop/avoid by 1 m to sides, 2 m in front
- ...

3. Driving in urban traffic
4. Intersection operations
5. Parking zone operations
6. Goal & contingency management

7. Startup, pit stops and repairs
- 5 min startup from receipt of MDF
- 2 min routine cleaning of all lenses and sensors in pit area (5 min maximum)
- ...

8. Testing
- Test plan with 1X expected course by July 2007, 10X expected course by NQE
- Quarterly tests by independent test team (ITT), linked to DARPA proposal milestones

9. Safety

Technology Readiness Levels

TRL	Description	Entry Criteria	
1	**Technology concept** - Review of literature shows technology concept is available & potentially useful	Documented on wiki or bugzilla	• SURF06 • CEM 75ab • CDS 110+ • EE 148+ • ME 131+ • ...
2	**GOTChA chart** has been developed for the project indicating how a given technology might be applied	GOTChA chart posted on wiki	
3	**Desktop demo** - demonstration of the key ideas is available via a hardware mockup or MATLAB demo	Preliminary design and demo posted on wiki	
4	**Prototype implementation** - documented initial demo of the technology that verifies key objectives	Documented design with external review	
5	**Alice demonstration** - demo of the technology on Alice (or using logged data); not yet baseline code	Demonstration on Alice	
6	**Reviewed design** - successfully pass design review, including implementation in standard code/hardware base on Alice documention on wiki and doxygen	Pass formal design review	• CEM 75c • Indep proj
7	**Integrated module** - integrated into standard code/ hardware base; tracked w/ config mgmt process	Build manager/imple-mentation team signoff	• Implement ation team • SURF07
8	**Flight tested** - demonstrated in an Integrated Test Team (ITT) sponsored test	Documented performance in ITT test	
9	**Race ready** - tested for 100+ hours of operations in a race-like environment.	Documented operation for 100+ hours	

GOTChA Chart

Goals (1-3)

- Describe the goals of your project, in plain English
- Description should be understandable to your engineering friends (avoid jargon)
- Tie to the overall project goal

Objectives (3-6)

- Specific tasks that you need to complete in order to accomplish your goals
- Objectives should be "SMART"
  - Specific - concrete descriptions
  - Measurable - can tell whether you accomplished them or not
  - Attainable - possible to complete in time available
  - Relevant - lined up with system spec
  - Trackable - possible to monitor progress as you go
- Guide: try to include numbers and dates, when possible

Technical Challenges (4-8)

- List of problems that you expect to face in accomplishing your objectives
- Try to list anything that you are not sure about
- OK to include things that you don't yet know (eg, programming in C/C++, implementing a vision algorithm, etc)

Approach (4-8)

- Describe how you are going to tackle the technical challenges that will let you accomplish your objectives to satisfy your goals
- Make sure all of the technical challenges are addressed (otherwise how will you overcome them?)
- Can serve as a work plan for the term - what do you want to do first, next, etc

Example: Project GOTChA, Winter 2005

Goals

- ✔ Shift main operations and testing from Bob to Alice.
- ✔ Have Alice fully actuated, instrumented and operational in time for spring field tests
- ✔ Submit technical specifications and video of Alice working for DARPA
- P Develop onboard self-contained Alice testing capability for efficient testing

Objectives

- P Spring Field Test: 10 miles of autono-mous driving at 10 mph average speed
    - ✔ Documented and demonstrated vehicle, actuator and state estimate interfaces
    - P Fully populated sensor suite capable of measuring surrounding terrain w/in specs
    - ...
- ✗ User interface framework capable of remotely starting/stopping modules, displaying debugging information, and commanding parameter changes
- ...

Technical Challenges (4-8)

- Early development of a robust vehicle and driving/state interface that avoids problems we encouraged last year
- Integration of a large number of SW, HW and operational modules across diverse team w/ no full time systems engineers
- Weak plan for integrating road following and gimbaled sensor platform into final platform
- No specific course to work on terrain and vehicle tasks - requires a large amount of volunteer work
- Difficult to find field test time in the midst of classes

Approach (4-8)

- Test-focused plan - drive progress via critical and baseline objectives for W3, W6, W9 tests
- use of winter term courses for providing time to work on project
    - CS 11, ME/CS 132, CDS 110
    - Partnerships/vendors: contract out vehicle components (Sportsmobile)
- Exploit volunteer collaborations: JPL, Northrop, STI

Best Practices for Teams

Meetings

- Meetings should be announced via e-mail ahead of time, with goals and agenda
- Agenda item #1: goals and agenda
- Someone should be designated to take notes and send to team (or post on web)

Documentation

- Documentation is *critical* if you want your work to be used by others
- Don't wait until the end to document; document as you go
- All documentation belongs in the Wiki (searchable, revision tracking, etc)

Subversion

- All source material (code, design, anything that changes over time) should be archived via Subversion
- Teams should figure out SVN structure before starting to write code
- More on using Subversion in a few weeks

Bugzilla

- Use bugzilla to keep track of all tasks and status on tasks
- Update bugzilla entries before team meetings, when possible
- More on Bugzilla next week