CIS 3250: Software Design III

Module I:
Project Management Tools

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School of Computer Science

Reminder Readings This Section

- ✓ Project Management Basics (Definitions, Scheduling)
  - ✓ Smith Ch 1 & 9
- ➢ Project Scheduling & Management Tools
  - ➢ Smith Ch 11 & 14, McConnell Ch 28 (§3)
- Configuration Management
  - McConnell Ch 1, Ch 28 (§1, §2)
- Book Chapter (on CourseLink): Whitehead et al. (2010). **Collaborative Software Engineering: Concepts and Techniques (Ch 1)**, particularly §1.1, §1.2, §1.5, §1.6
- Keep up with weekly readings, or you will NOT do well on your exams! This is a heavy "concepts" based course.

Project Management Complexities

- Balancing various project success factors is complex
  - Is the project on budget
  - Is the project on schedule
  - What resources are available for the project?
  - Are we coordinating resources effectively?
  - What options do we have when the customer requests a change?
  - What basis do we have for estimating level of effort and resources required for the next project?

Project Management Tools Outline

- Conceptual tools for project scheduling (and resource allocation)
  - Project scheduling basics
  - PERT Chart
  - Gantt Chart

Note, in class Gantt charts were covered 1st, to align with lab activities. Yet, a more logical ordering is included in these notes.

- Software tools for overall project management (including scheduling, resource allocation, accountability, project control, etc.)
  - PM software key features
  - PM software examples

How Do Software Projects Fall Behind?

"One day at a time." – Fred Brooks

Announcements

- Please upload all Assignment #1 materials to your **Trello Board**, not CourseLink…follow the instructions in your Assignment instruction for each respective assignment for where to upload each deliverable component.
  - This way the TAs know where to find things

- Students who sign up for a Student Developer Pack through GitHub Education are eligible for free private GitHub repositories
  - https://education.github.com/pack/offers

Review

- What is the difference between a **task** and an **activity** in SE?

- What is a project **life cycle**? What are some examples in SE?

- What is a **Gantt chart**? What's its purpose?
- What is a good starting point for creating a **Gantt chart**?
- What are some common features of a **Gantt chart**?

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Project Scheduling: Basic Concepts

Some **root causes** of why software is delivered late:

- Unrealistic deadlines established by someone outside the software team and forced on managers and team
- Changing customer requirements that are not reflected in schedule changes
- Honest underestimation of the amount of required effort and/or resources
- Predictable and/or unpredictable risks that were not accounted for at the beginning of the project
  - Technical difficulties, personnel, or organizational issues, etc.
- Failure by project management to recognize and/or react to the project failing behind

Project Scheduling Realities

- If best estimates indicate that the deadline is unrealistic, a competent project manager should **"protect their team" and push back** on whoever is originating the deadlines
- Stakeholders should work together to negotiate deadlines (in a realistic manner)
- If a certain schedule is important, what are some options:
  - Negotiate other **project success constraints** instead of schedule until estimates of required effort/resources align with schedule
  - Use an **incremental process model** that delivers critical functionality by the imposed deadline, but that delays other functionality until later

Software Project Scheduling

Defn: "An activity that **distributes estimated effort** across the planned project duration by **allocating the effort to specific software engineering tasks**."

The project schedule **evolves over time**

- Early schedules typically include high-level modeling of major project phases over time and their associated product functions
- As project evolves, each entry on high-level schedule is broken down further, using outputs from the WBS

Two Common Project Scheduling Tools

- **PERT** and **Gantt charts** are project management tools used to schedule, organize, and coordinate tasks within a project
  (searchsoftwarequality.techtarget.com)
- PERT (Program Evaluation Review Technique) Chart
  - Also called Precedence Network Chart
  - Visually models the **dependencies among project tasks** and activities
- Gantt Chart
  - Visually models the **project activities along a time-scaled axis**
  - Allocates project tasks and activities to project resources (personnel/roles, equipment, etc.)

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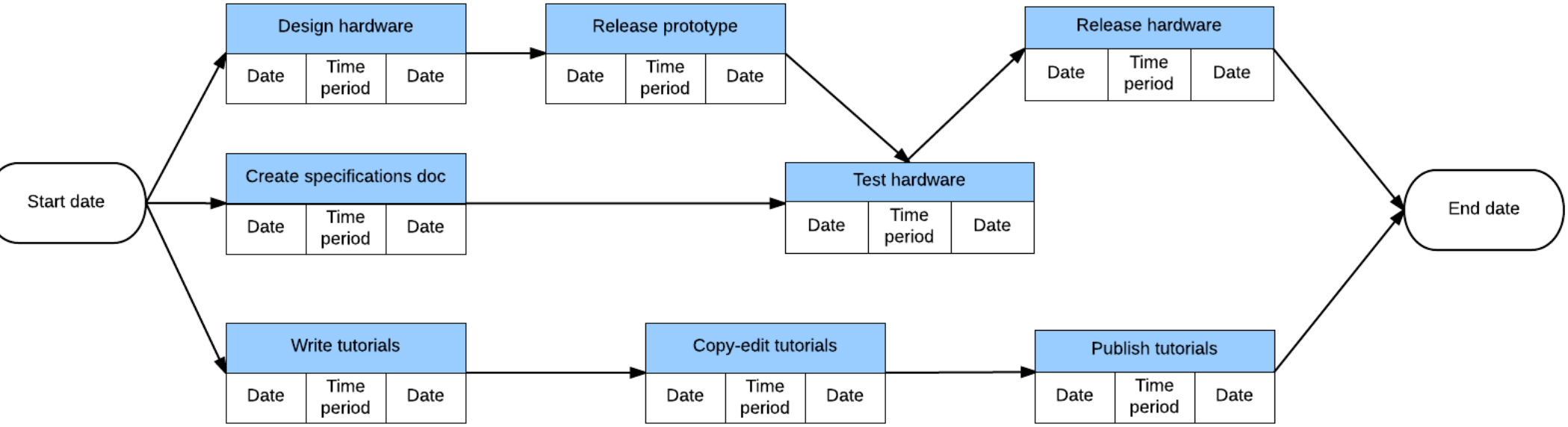
PERT Chart

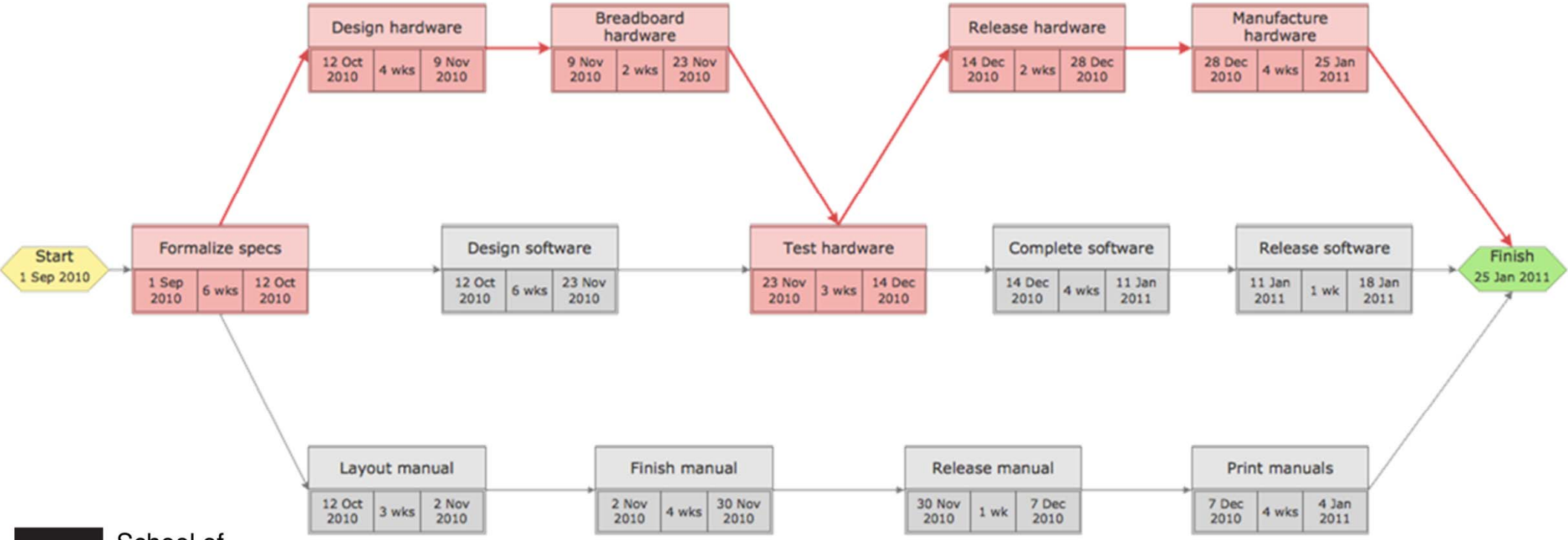
- PERT = Program Evaluation Review Technique
- Displays **task dependencies** (which tasks need to be done before others can be started)
- PERT Chart contains a **precedence network or diagram** (i.e. a network diagram/graph that clearly identifies the dependencies between tasks)



https://d2slcw3kip6qmk.cloudfront.net/marketing/blog/2017Q2/PERT-chart-example-2.png

PERT Chart: "critical path" and "float"

- PERT charts can be used to determine the **"critical path"** in a project
- **Critical path:** The sequence of project activities that are **most time-dependent**. i.e. there is no **"float"** in their estimated completion time
- **Float** is the amount of time by which a non-critical activity can be delayed before it causes subsequent activities to be delayed.

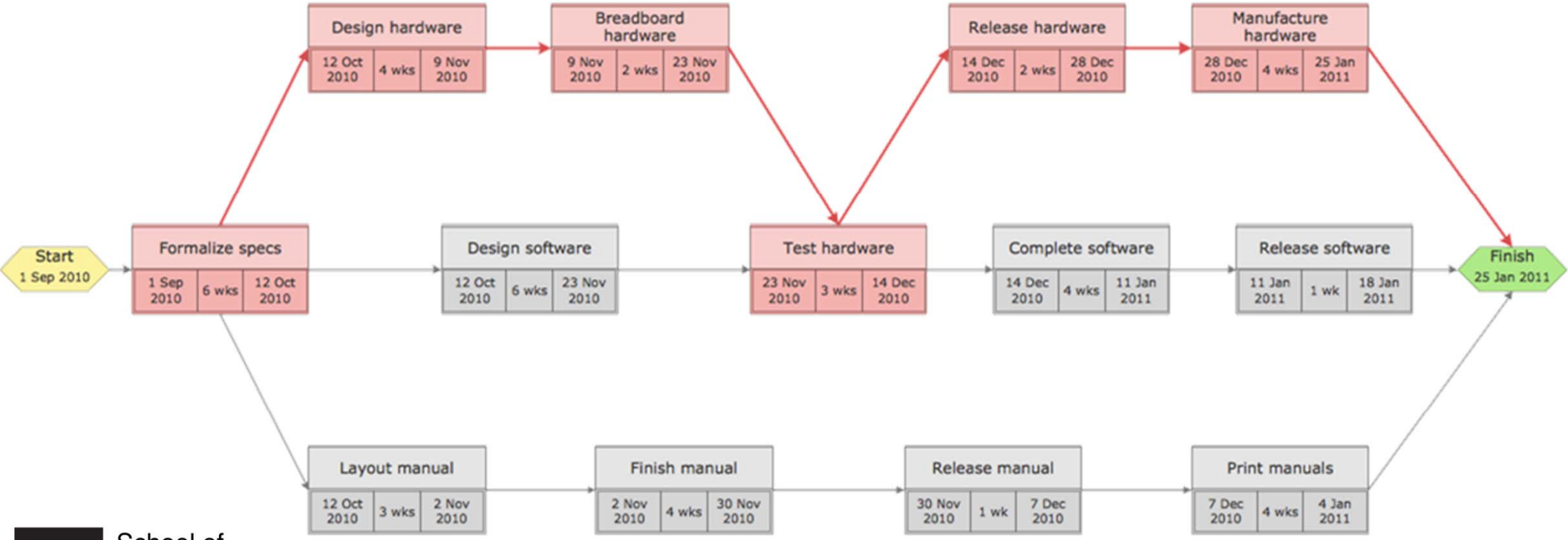


http://www.conceptdraw.com/samples/resource/images/solutions/project-chart/PROJECT-CHART-PERT-Chart-Software-Development-Plan.png

PERT Chart Exercise

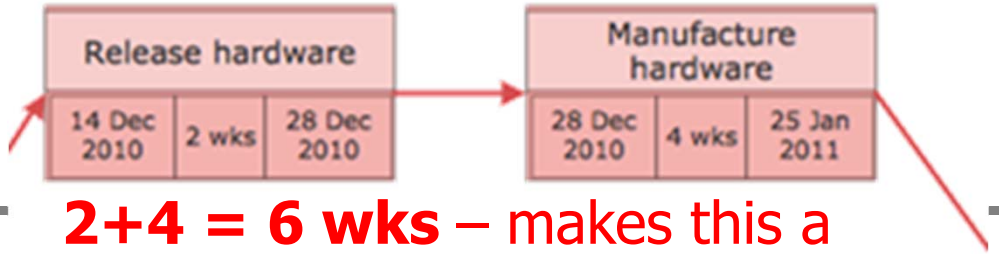
Critical path: The sequence of project activities that are **most time-dependent**. i.e. there is no **"float"** in their estimated completion time

Q: Which of the task sequences in this example (and on handout) is the **critical path?**



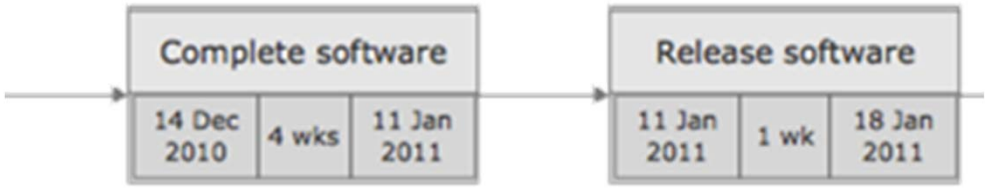
http://www.conceptdraw.com/samples/resource/images/solutions/project-chart/PROJECT-CHART-PERT-Chart-Software-Development-Plan.png

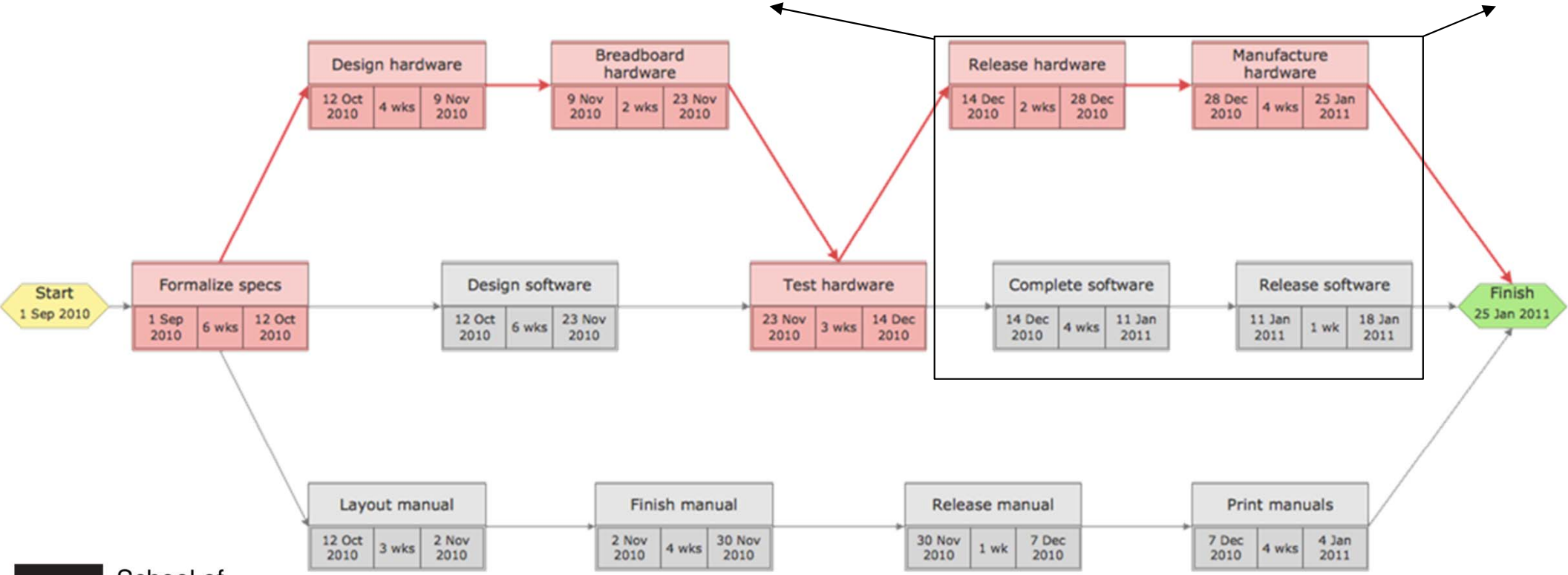
PERT Chart



2+4 = 6 wks – makes this a "critical" task sequence

4+1 = 5 wks

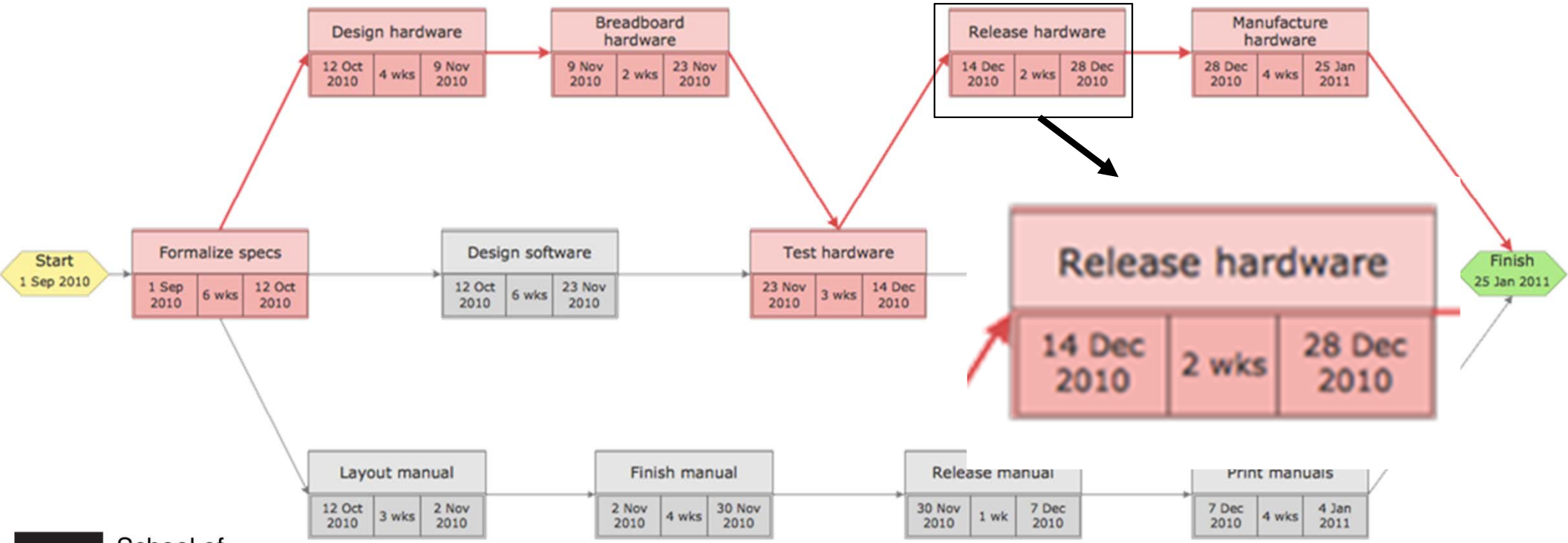




http://www.conceptdraw.com/samples/resource/images/solutions/project-chart/PROJECT-CHART-PERT-Chart-Software-Development-Plan.png

Common Features of a PERT Chart

- A visual "network" graph that shows the dependencies between project tasks using nodes (task or task deadlines) and directed edges
- Time estimates of task activities, sometimes with specific start and end dates



http://www.conceptdraw.com/samples/resource/images/solutions/project-chart/PROJECT-CHART-PERT-Chart-Software-Development-Plan.png

Recipe for Creating a PERT Chart

1. Create an **activity list** (e.g. WBS): They are the list of tasks or activities that need to be completed within the project.
2. Create a **precedence diagram**: This is a project network diagram that illustrates the activity flow in the project. The dependencies between each activity are clearly identified. The image below illustrates a Precedence diagram.
3. Assign **estimates** for each task/activity: The estimated time to complete each activity.
4. Identify the **critical path**: The longest activity execution path within the network diagram.
5. Calculate the **float** of each activity: The slack of each activity in the project network diagram.

https://www.brighthubpm.com/certification/61931-critical-path-and-pert-networks-similarities-and-differences/

Example WBS II

Work Breakdown Structure for Writing Project	
1.0	Planning
1.1	Create outline
1.2	Determine authors, responsibilities, writing timelines
1.3	Determine sharing mechanism
2.0	Literature Review
2.1	Research
2.1.1	Searching/finding papers
2.1.2	Add papers to Mendeley (bibliography library)
2.2	Planning
2.2.1	Determine themes
2.2.2	Create outline
2.3	Writing
3.0	Method
3.1	Gather data from Marvin's Thesis on study method
3.2	Determine structure/presentation of method
3.3	Detail experimental design & data collection/analysis
3.4	Write method
4.0	Data Analysis / Study Results
4.1	Review data analysis for completeness/validity
4.2	Consult with stats expert
4.3	Interpret data analysis results
4.4	Determine the key results & overall story of findings
4.5	Organize and outline results section

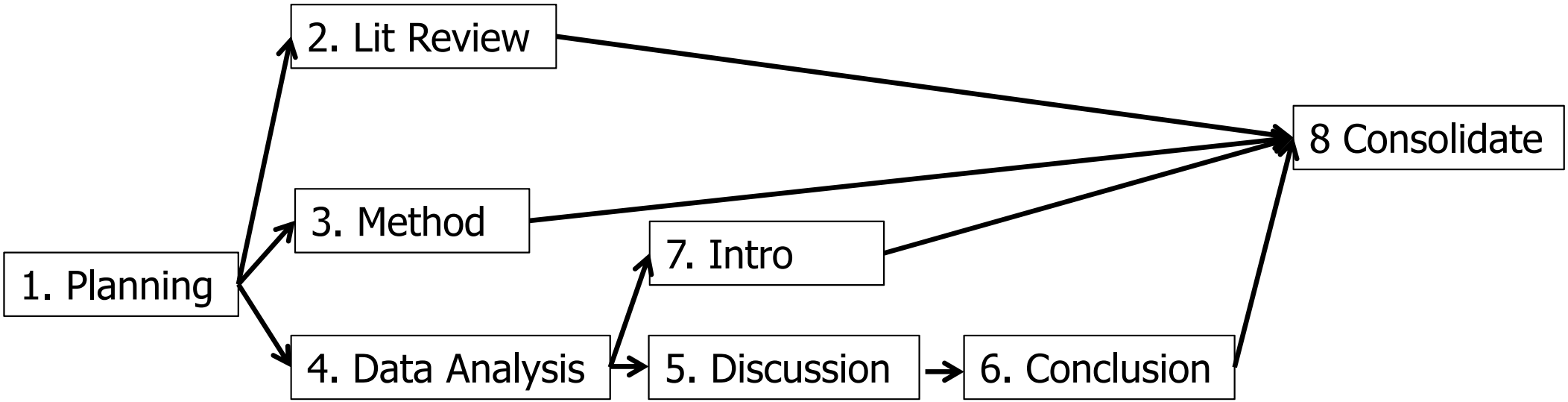
Example WBS II

	Cont'd
5.0	Discussion
5.1	Brainstorm the implications of the study with Marvin
5.2	Compare & contrast results with prior literature
5.3	Determine key themes
5.4	Outline
5.5	Write discussion section
5.6	Write limitations section
6.0	Conclusion
6.1	Summarize main contributions
6.2	Brainstorm potential future work
6.3	Write conclusion section
7.0	Introduction
7.1	Based on results, determine key framing of paper
7.2	Determine 2-3 main contributions; articulate
7.3	Outline
7.4	Write introduction section
8.0	Consolidate all sections & revise/edit
8.1	Consolidate & put paper in proper format
8.2	Review accuracy of references
8.3	Revise and edit for content, grammar, page length
8.4	Take to SoCS Writing Circle for feedback

Main Activities for Paper Writing Project

1. Planning
2. Literature Review
3. Method
4. Data Analysis
5. Discussion
6. Conclusion
7. Introduction
8. Consolidation/editing
9. Submit paper

Beginnings of the PERT Chart for the Writing Project…the Precedence Network/Diagram



Project Management Tools Outline

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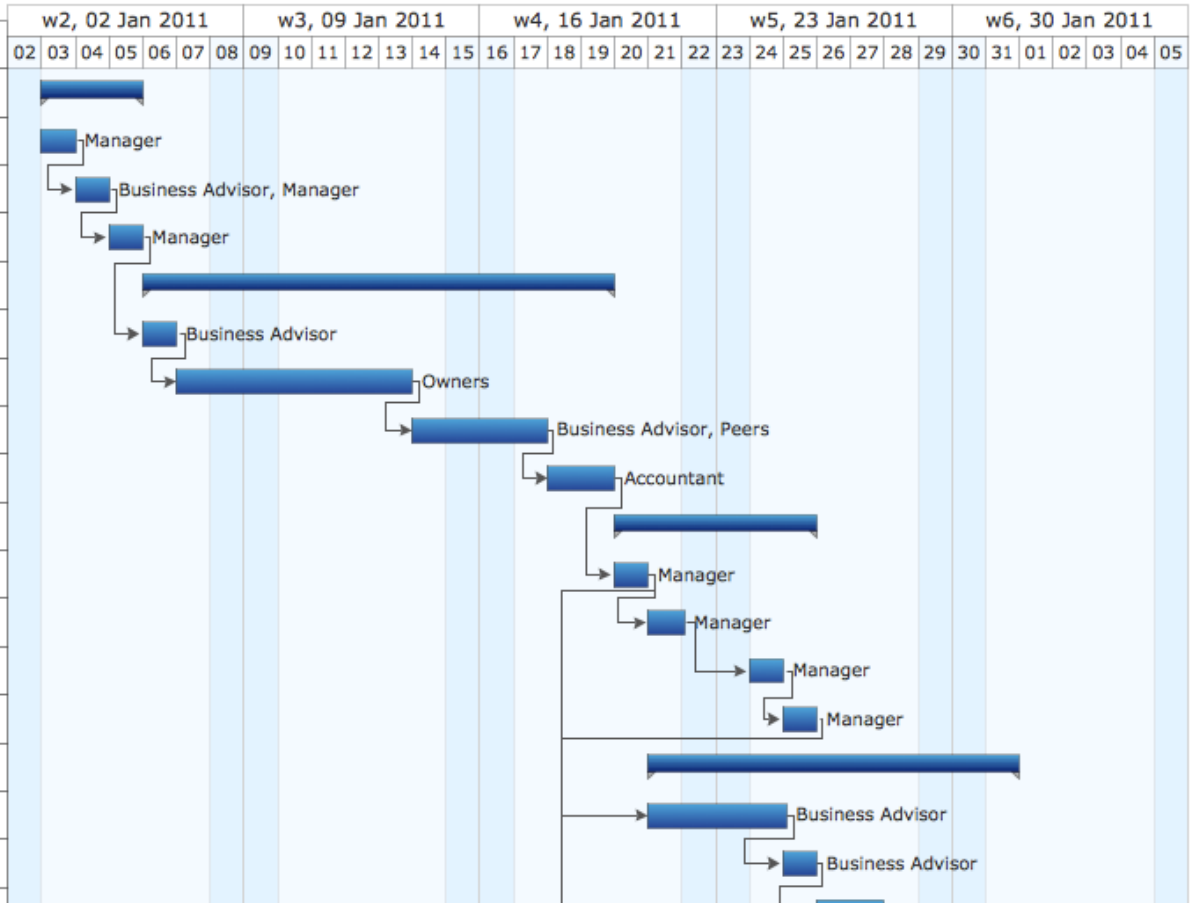
Gantt Chart

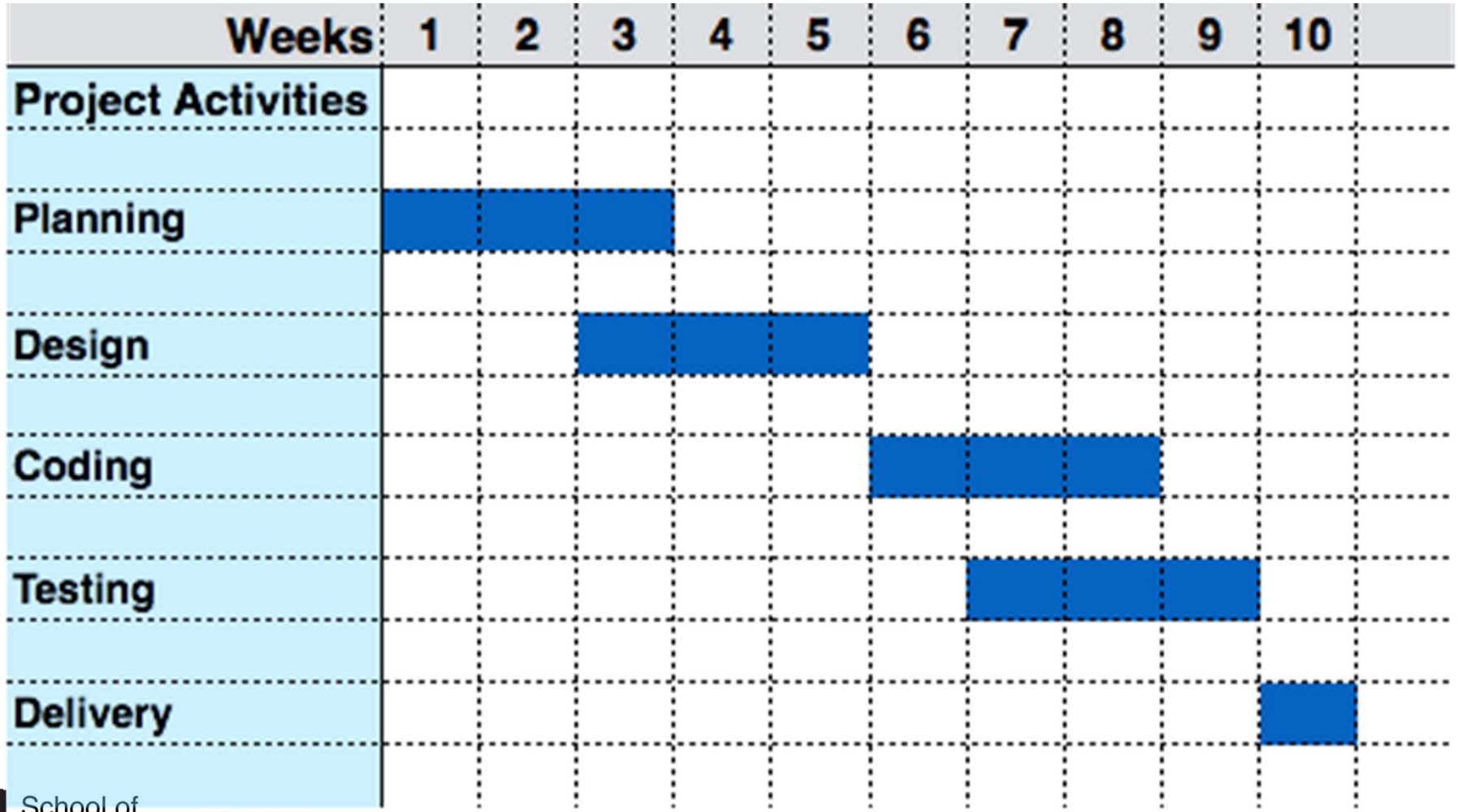
- Displays tasks along a project timeline, **scaled by time**
- Displays **task allocations to project resources**

#	Name	Duration	Start	Finish
1	Self-Assessment	23,0 d	03.01.2011	05.01.2011
2	Define business vision	1,0 d	03.01.2011	03.01.2011
3	Identify available skills, information and support	1,0 d	04.01.2011	04.01.2011
4	Decide whether to proceed	1,0 d	05.01.2011	05.01.2011
5	Define the Opportunity	10,0 d	06.01.2011	19.01.2011
6	Research the market & competition	1,0 d	06.01.2011	06.01.2011
7	Interview owners of similar businesses	5,0 d	07.01.2011	13.01.2011
8	Identify needed resources	2,0 d	14.01.2011	17.01.2011
9	Identify operating cost elements	2,0 d	18.01.2011	19.01.2011
10	Evaluate Business Approach	4,0 d	20.01.2011	25.01.2011
11	Define new entity requirements	1,0 d	20.01.2011	20.01.2011
12	Identify on-going business purchase opportunities	1,0 d	21.01.2011	21.01.2011
13	Research franchise possibilities	1,0 d	24.01.2011	24.01.2011
14	Summarize business approach	1,0 d	25.01.2011	25.01.2011
15	Evaluate Potential Risks and Rewards	7,0 d	21.01.2011	31.01.2011
16	Assess market size and stability	2,0 d	21.01.2011	24.01.2011
17	Estimate the competition	1,0 d	25.01.2011	25.01.2011



Super Simple Gantt Chart

Provides minimal project scheduling information, but not very useful for coordinating resources and anticipating issues

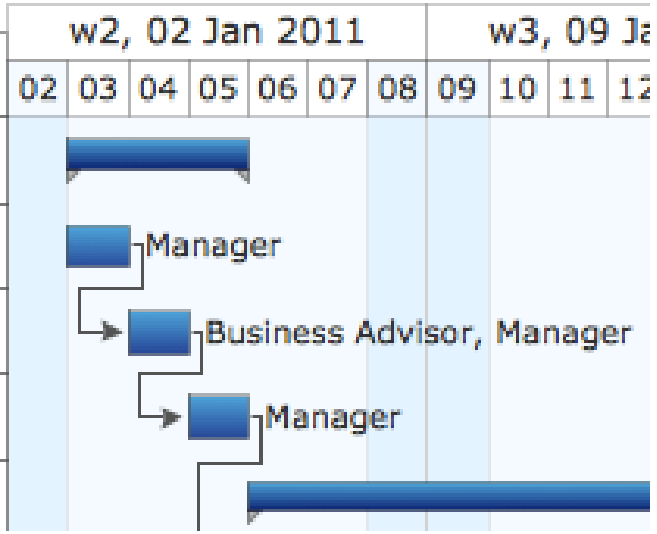


https://www.tutorialspoint.com/software_engineering/images/gantt_chart.png

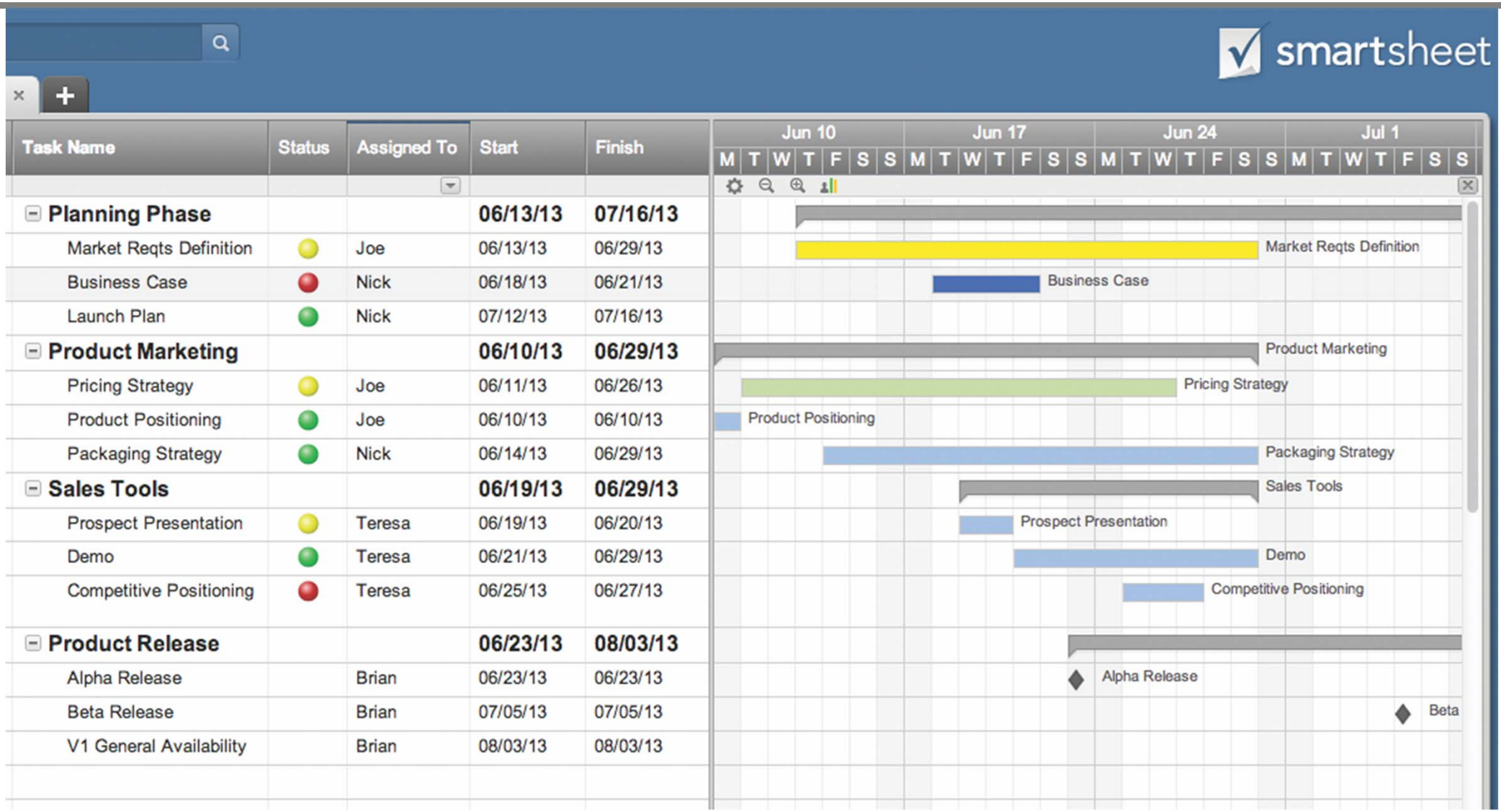
Common Features of a Gantt Chart

- Detailed **list of tasks**, typically grouped into a higher-level activity
- Tasks usually listed in chronological order
- **Duration** of each task
- **Resources** allocated to the task
- Start/end dates on timeline, and sometimes listed in text

#	Name	Duration	Start	Finish
1	Self-Assessment	23,0 d	03.01.2011	05.01.2011
2	Define business vision	1,0 d	03.01.2011	03.01.2011
3	Identify available skills, information and support	1,0 d	04.01.2011	04.01.2011
4	Decide whether to proceed	1,0 d	05.01.2011	05.01.2011
5	Define the Opportunity	10,0 d	06.01.2011	19.01.2011



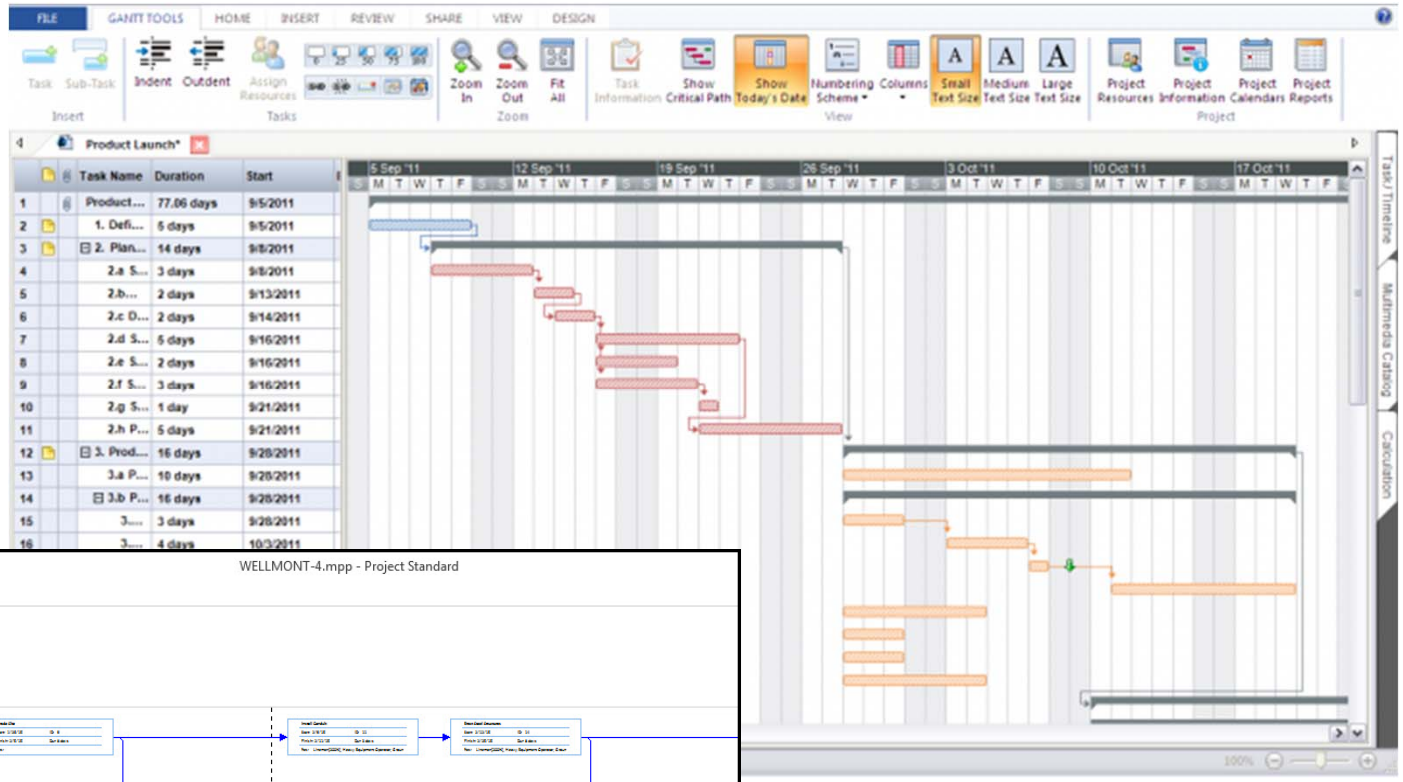
More Elaborate (and More Typical) Gantt Chart

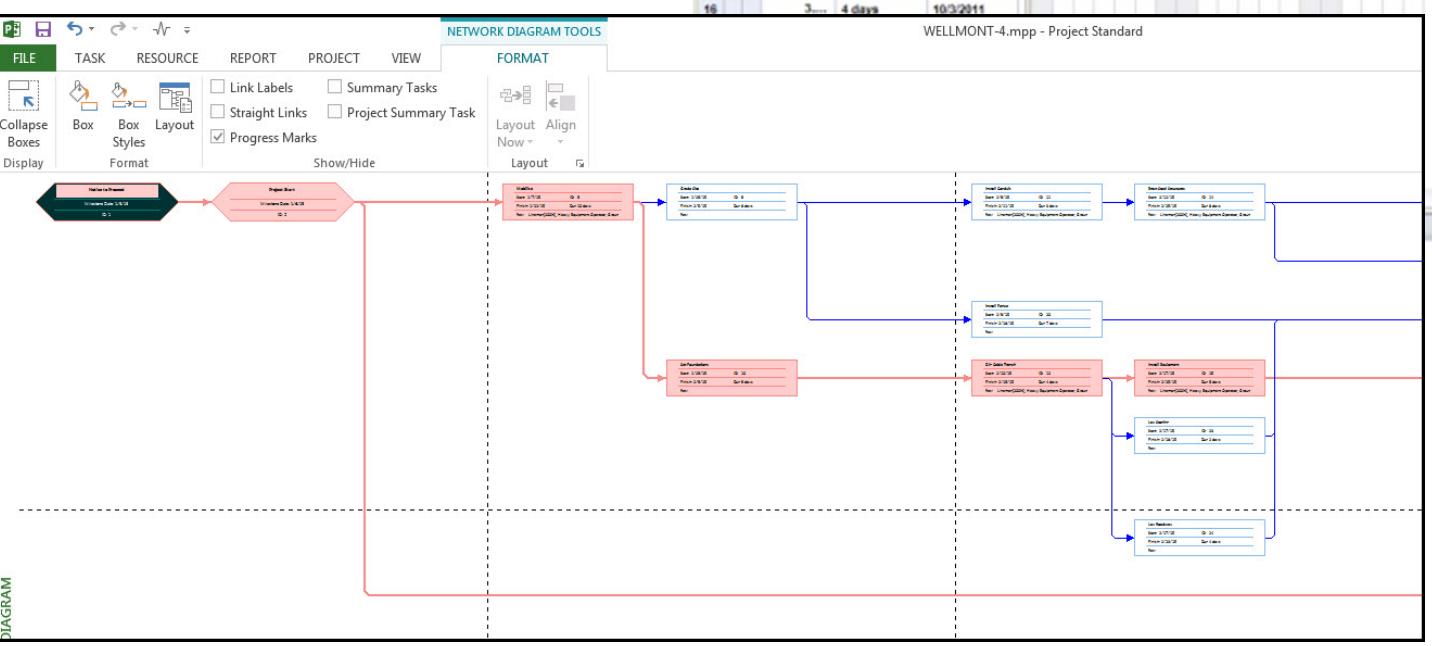


Task Name	Status	Assigned To	Start	Finish
Planning Phase			**06/13/13**	**07/16/13**
Market Reqts Definition		Joe	06/13/13	06/29/13
Business Case		Nick	06/18/13	06/21/13
Launch Plan		Nick	07/12/13	07/16/13
Product Marketing			**06/10/13**	**06/29/13**
Pricing Strategy		Joe	06/11/13	06/26/13
Product Positioning		Joe	06/10/13	06/10/13
Packaging Strategy		Nick	06/14/13	06/29/13
Sales Tools			**06/19/13**	**06/29/13**
Prospect Presentation		Teresa	06/19/13	06/20/13
Demo		Teresa	06/21/13	06/29/13
Competitive Positioning		Teresa	06/25/13	06/27/13
Product Release			**06/23/13**	**08/03/13**
Alpha Release		Brian	06/23/13	06/23/13
Beta Release		Brian	07/05/13	07/05/13
V1 General Availability		Brian	08/03/13	08/03/13

Most PM Tools include Gantt and PERT Charts (more on PM tools later)

Microsoft Project





Project Management Software

- Most medium- to large-scale projects require formalized management software to help manage project complexities
- There are hundreds of project management software solutions available, including many free ones
- They all offer differing levels of project management support, aimed at supporting different types of project complexities

“Top” PM Tools? … It depends!

- Smith text mentions Microsoft Project and Primavera
  - MS Project is commonly listed in modern “top 5/10” lists of PM tools
  - Primavera is mentioned less often, and it typically more suited to larger, enterprise projects that have to manage many projects at once. It’s consider more of a “portfolio” PM tool, rather than a single project PM tool

Other "Top 10/20" Lists: Capterra survey (based on "Popularity" measures)

Capterra **Top 20 Most Popular Project Management Software - Version 6**

	Customers	Users	Twitter	LinkedIn	Faceboo
Microsoft Project	880,000	22,000,000	29,926	3,891,323	246,
Wrike	1,200,000	2,000,000	10,419	12,030	14,
Atlassian	40,000	52,000,000	24,736	91,018	157,
Basecamp	285,000	15,000,000	887	11,405	11,
Podio	500,000	2,500,000	17,040	218,511	20,
Asana	140,000	1,400,000	115,000	16,023	213,
Trello	72,647	4,750,000	149,147	12,666	87,
Teamwork Project Manager	343,638	3,436,378	8,611	2,241	23,
Smartsheet	100,000	1,500,000	10,464	14,011	10,
Freedcamp	400,000	650,000	1,955	383	3,
Project Manager	110,000	550,000	33,141	5,408	65,
VersionOne	50,000	1,250,000	7,996	6,250	4,
Assembla	80,000	1,000,000	4,760	821	10,
ProofHub	85,000	900,000	17,903	2,295	2,
Zoho Projects	20,000	1,200,000	1,458	63,671	129,
Mavenlink	50,000	750,000	8,990	5,251	17,

Other "Top 10/20" Lists: everhour.com

Well Known Project Management Tools			
Name	**Focus**	**For Whom**	**Rating**
Asana	Quick task tracking & comm.	For the CEO and the product manager	4.5 / 5
Trello	Kanban boards, visual planning	Individual team members, collaborative brainstorming	4.5 / 5
Basecamp	Handling small projects and remote teams	Businesses with small, repeat-able projects, everyday users	4 / 5
TeamWork	Task communication and collaboration	Project and task management for more experienced users	4.5 / 5
Less Famous, But Worth Checking			
Clubhouse	Trello on steroids for s/w, great development pace	Sits close to Trello, but more for agile development teams	4.5 / 5
ActiveCollab	Simple tasks that require collaboration	Task and project management for small teams	4.5 / 5
Specifically For Software Development			
JIRA	Software task management	Software devs, managers	4.5 / 5
Pivotal Tracker	Scrum agile methodology	Between JIRA and Trello, very opinionated in workflow	4.5 / 5

Clearly, different tools are designed to support different project contexts

- So, what are some key project management traits we should consider when selecting a PM tool?

6 Key Areas of Functionality for PM tools

- Scheduling
- Cost management
- Risk management
- Human resource management
- Communications management
- Process management

Not listed by Smith but many "requirements lists" from expert PMs also list:

- Good usability / UX

Announcements

- **Clarification: Your Completed Gantt Chart must be finished THIS week (as part of Assignment #1) and added to your Trello site. It must include a representation of all assignments (to the details you have).**
- 2 upcoming programming events (details on CourseLink):
  - Sept 27: CODE/DESIGN to Win, Preliminary Design Challenge @ UofG
  - Sept 28-30: Game Jam @ UWaterloo

Announcements: Upcoming Labs

- Next week (Week 4): Lab: Continuation of Git/GitHub concepts & begin Assignment #2 (You will be assigned your codebase in that lab)
- Week 5: No Lab due to **midterm #1**
- Week 6: No Lab: due to Thanksgiving / fall "break"
- Week 7: Lab – **finish Assignment #2**
- Week 8: Lab – start Assignment #3
- Week 9: Lab – **finish Assignment #3**
- Week 10: No Labs on Mon/Tues due to **midterm #2**, Lab for Fri
- Weeks 11-13: Lab – start and **finish Assignment #4**
  - NOTE, due to "make up classes" in Week 13, you will have 2, not 3 labs to complete this

Review

- What is the main purpose of a **PERT chart**?
- What are critical and non-critical activities in a **PERT chart**?
- What are some key differences between a **PERT chart** and a **Gantt chart**?

Think-Pair-Share: Reflecting on Scheduling

- Both PERT and Gantt charts assist a project team with scheduling, resource allocation, and other aspects of PM
- These planning activities help identify **project risks**

Q: Such as??

- Early schedules are **estimates**

Q: How do you come up with these estimates?

- During the project, the schedule should be **updated**

Q: What are some options if the schedule falls behind?

Recall: 6 Key Functionalities for PM tools

- Scheduling
- Cost management
- Risk management
- Human resource mgmt
- Communications mgmt
- Process management
- Good usability / UX

Discussion Question:

What types of **risks** are involved in a software project?

How do the specific application features in a PM tool can help with **risk management**?

Most PM tools also support

- Reporting
  - E.g., Produce graphs and tables for meetings
- Tracking
  - E.g. log project work and effort in terms of completed tasks
- What-if analysis
  - E.g. analyzing alternative project options, for instance, moving tasks around in the schedule, changing task assignments to see impact on schedule.
- Costing and accounting
  - E.g. assigning costs to resources and activities
- Timekeeping
  - e.g., recording actual time spent on project tasks

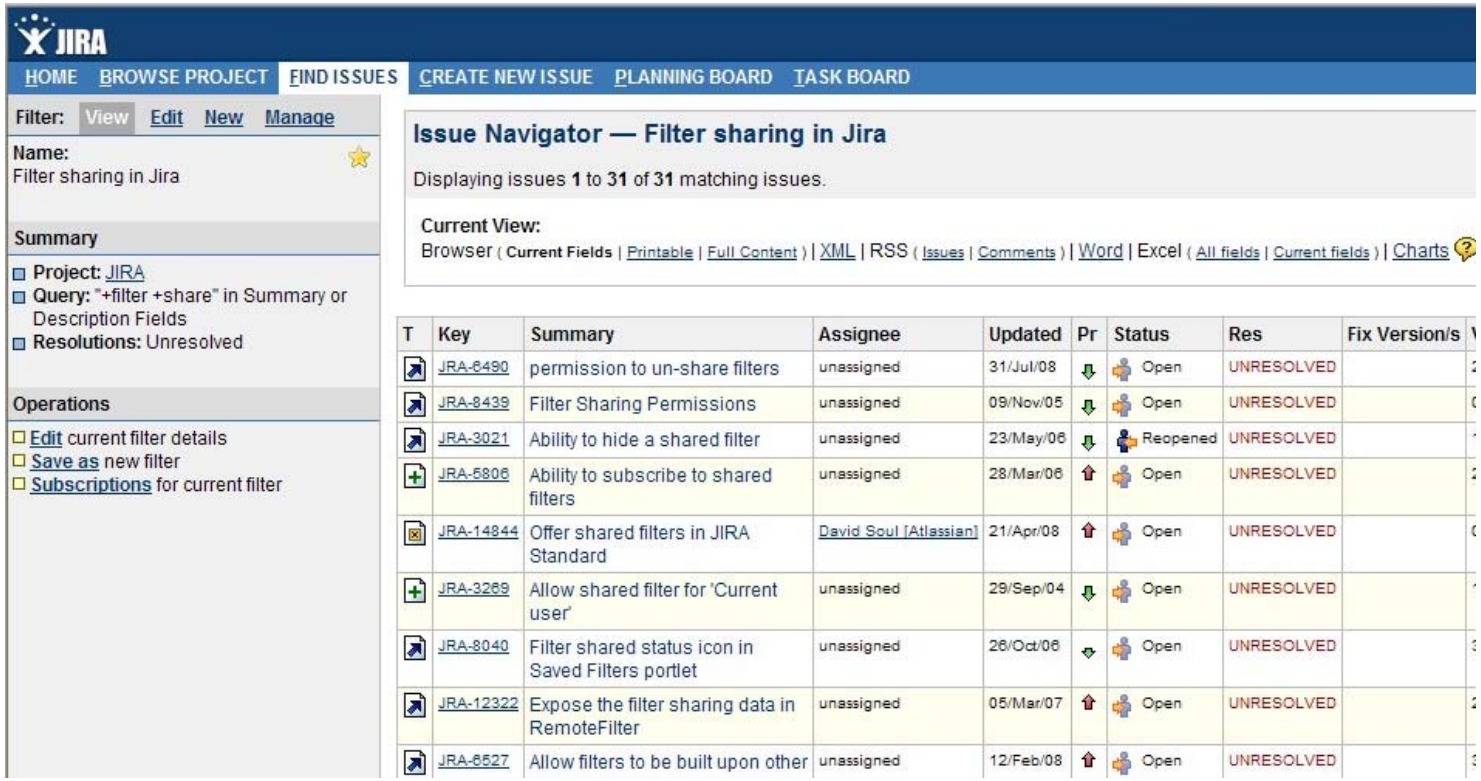
Useful Additional PM features for Software Projects

- Issue / bug tracking
- Version control

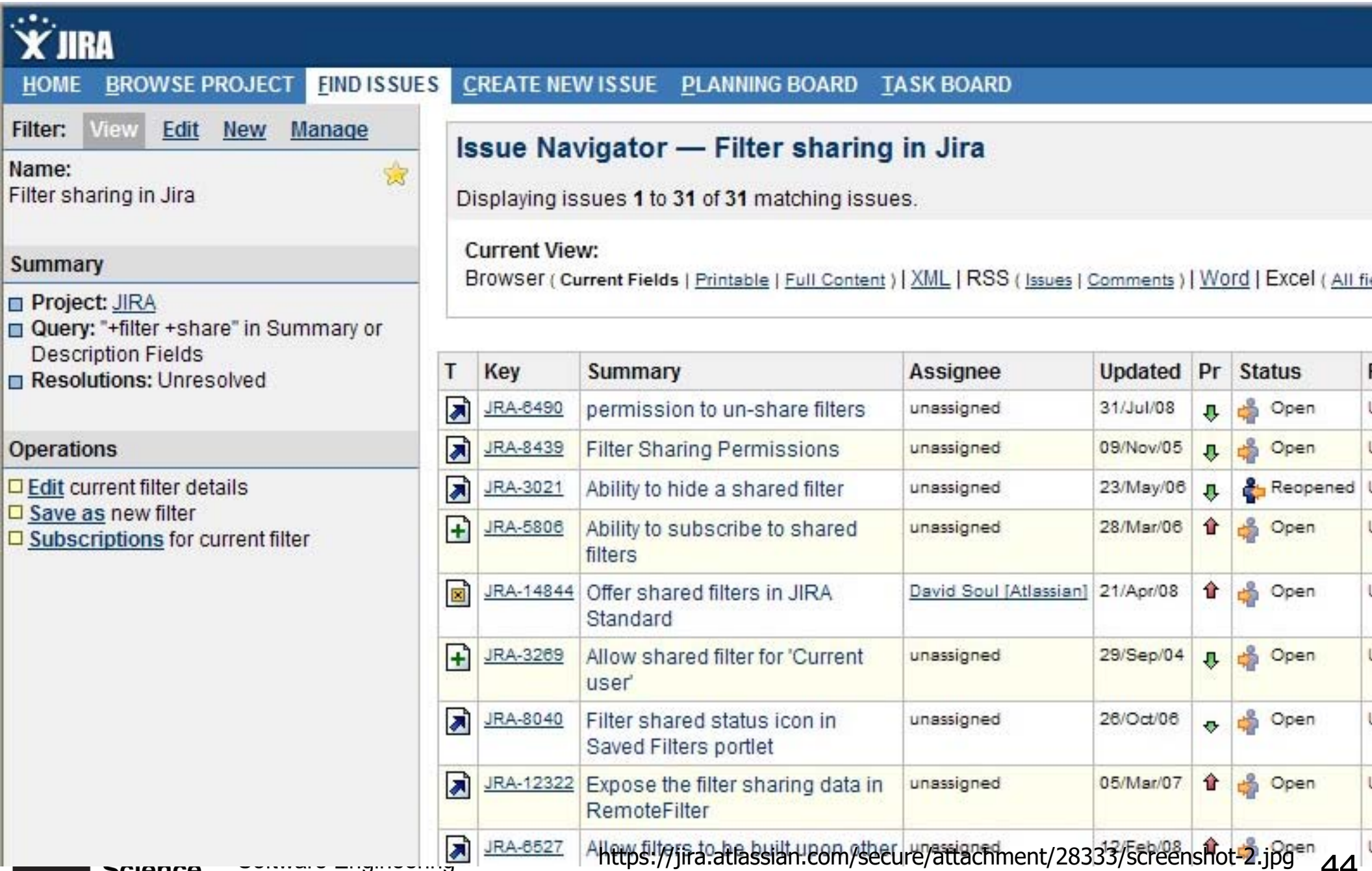
➢ Many **Software PM tools** have evolved from their origins as bug-tracking software

Let's Take an Example: Jira

- Jira is a PM tool, specifically designed for supporting Agile / Scrum software development projects https://www.atlassian.com/software/jira
- Early interface:



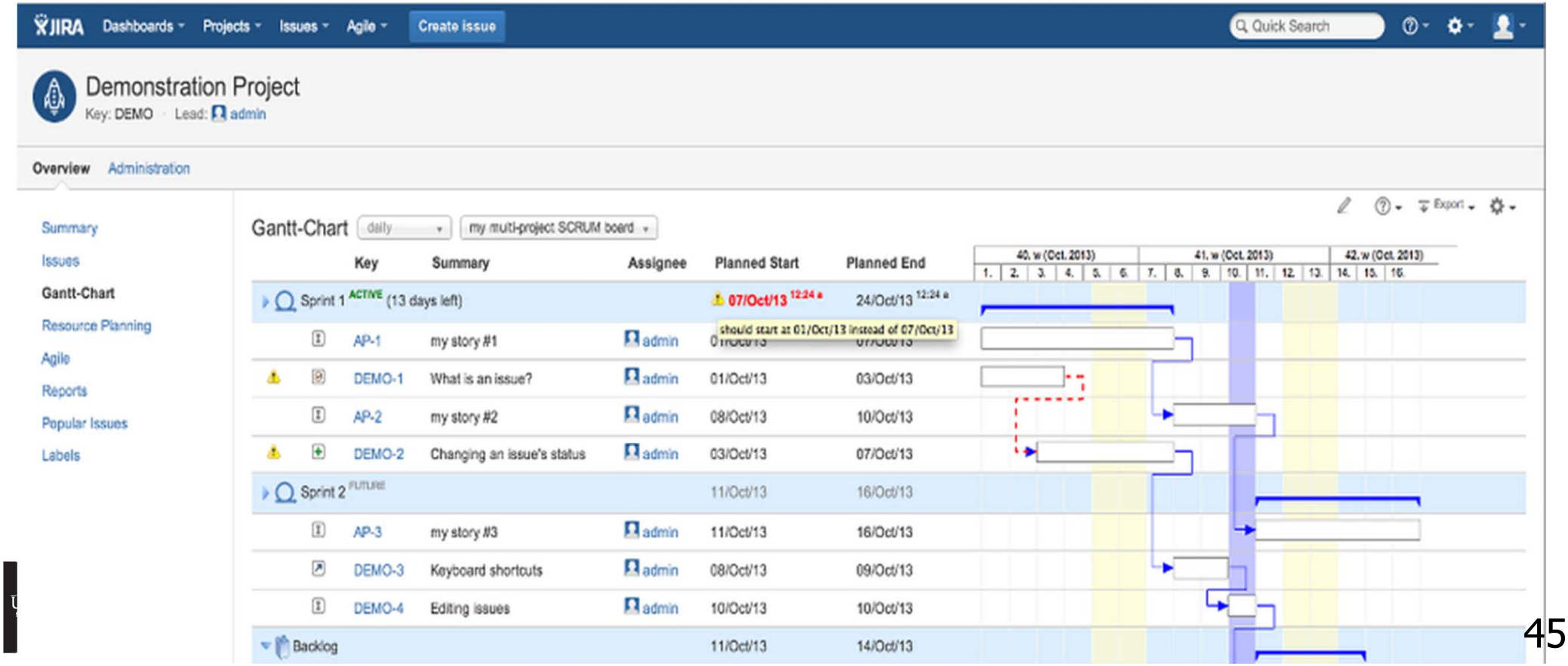
Let's Take an Example: Jira



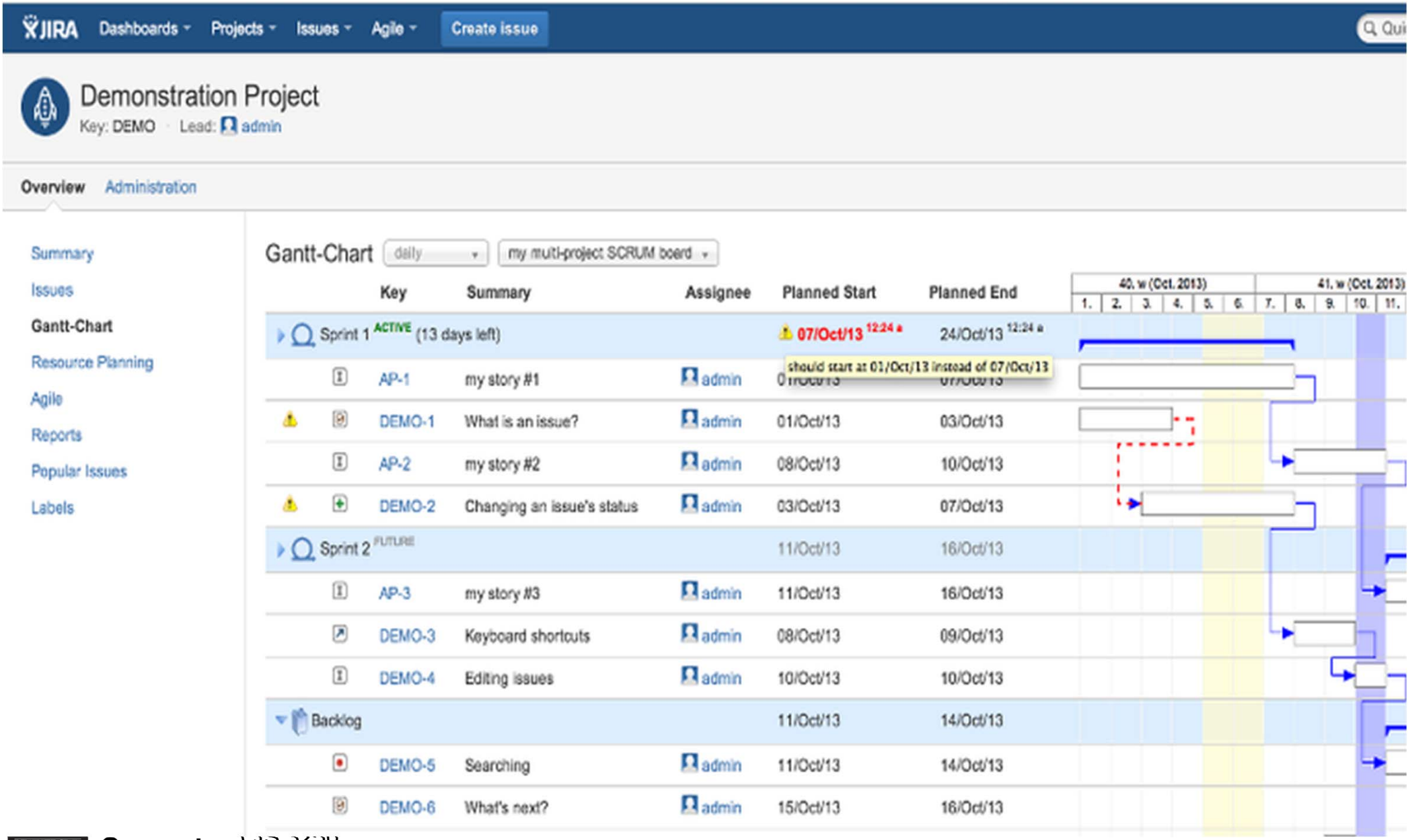
https://jira.atlassian.com/secure/attachment/28333/screenshot-2.jpg

Let's Take an Example: Jira (cont'd)

- Updated interface focuses on how issues integrate into the **project team's workflow (or process)**
- Many "Administrative" add-ons are available to provide higher-level PM support around planning, risk management, etc.
  - E.g. Gantt-chart add on



Let's Take an Example: Jira (cont'd)



Jira Intro Videos

- https://www.atlassian.com/software/jira
- https://www.atlassian.com/software/jira/demo
- Gantt Chart plug-in for Jira: https://youtu.be/9o4z7UvT5H8

- More comprehensive overview of Jira functionality (for you to watch at home): https://www.youtube.com/watch?v=ca8n9uW3afg&index=11&list=PLlALqRAjvdnGB_T0GAB1Fk2rVZgnJJAOa

Summary of Project Management Tools

- Project scheduling is an important part of project management
- PERT and Gantt charts are common tools to help with scheduling and resource allocation, both are visualizations of the project activities that each serve different purposing in project planning
- A wide variety of PM software tools exist to help with various aspects of project management
- Choosing the "right" PM tool depends on the project context
  - Team / organization size, project complexity, project process / workflow, project content, etc.

Readings This Section

- ✓ Project Management Basics (Definitions, Scheduling)
  - ✓ Smith Ch 1 & 9
- ➢ Project Scheduling & Management Tools
  - ➢ Smith Ch 11 & 14, McConnell Ch 28 (§3)
- Configuration Management
  - McConnell Ch 1, Ch 28 (§1, §2)
- Book Chapter (on CourseLink): Whitehead et al. (2010). **Collaborative Software Engineering: Concepts and Techniques (Ch 1)**, particularly §1.1, §1.2, §1.5, §1.6
- Keep up with weekly readings, or you will NOT do well on your exams! This is a heavy "concepts" based course.