INTERNET ENGINEERING

Basir University, 2020-2021

By: Prof. Dr. Mohammad Hajarian

- Session 5

3-TIER ARCHITECTURE + INTERACTION DESIGN AND FRAMEWORKS

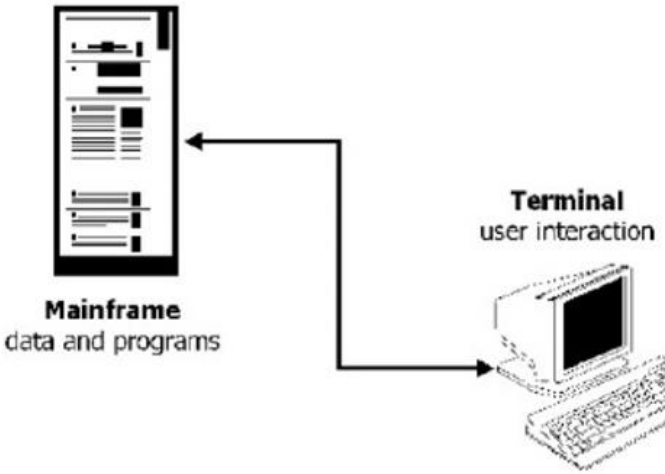
3-TIER ARCHITECTURE

SINGLE TIER AND DUAL TIER ARCHITECTURE

Dr. Mohammad Hajarian

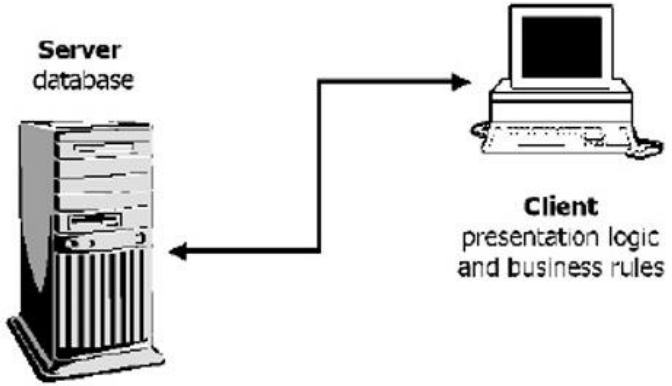
Single Tier Architecture

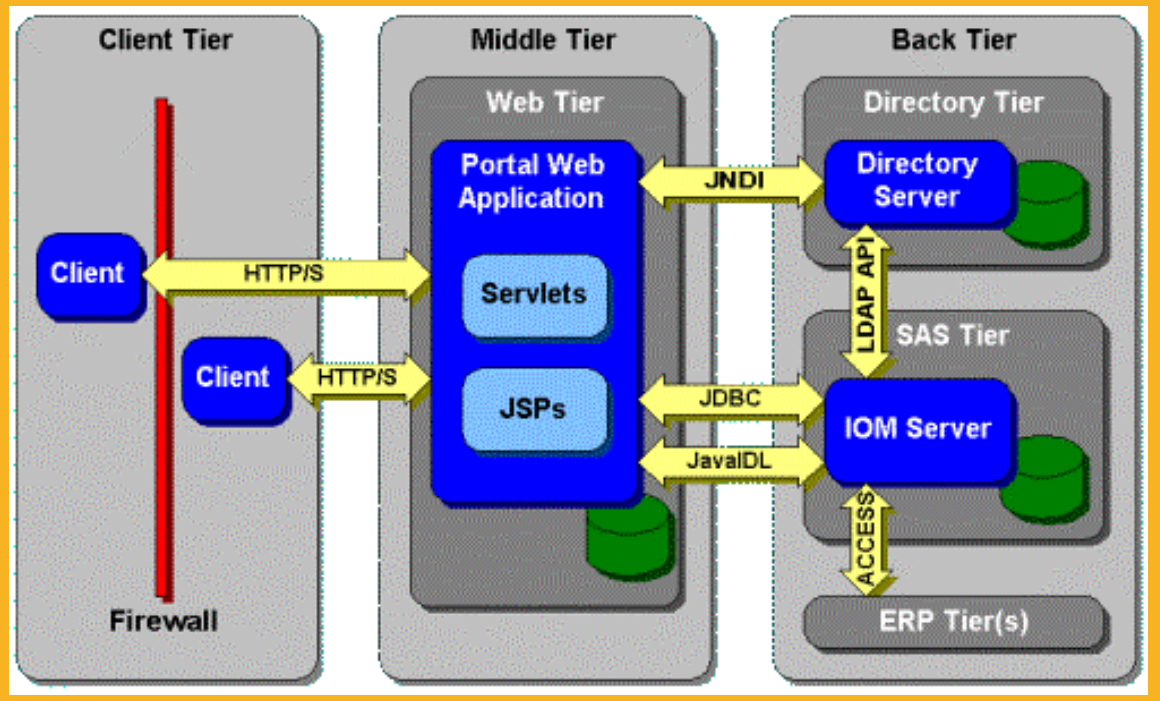
- Time of Huge "Mainframe"
- All Processing in Single Computer
- All Resources Attached to the same Computer
- Access Via Dumb Terminals



Dual Tier Architecture

- The Personal Computer
- Necessity of Providing Personal Software
- The Client Server Model was Born!!
- Logical System Components – Most of which are on the Client



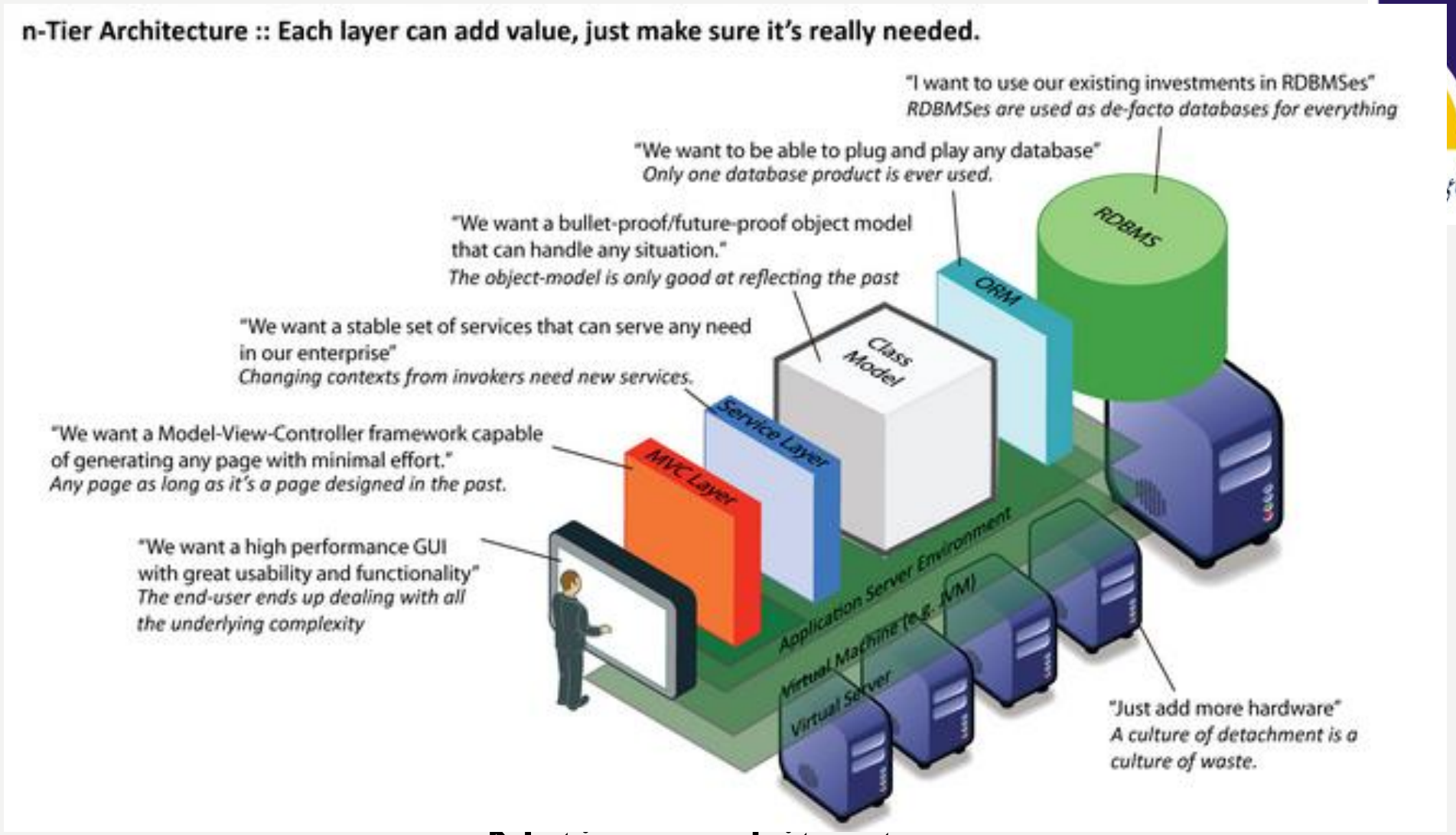


WEB APPLICATION ARCHITECTURE: MULTI-TIER (2-TIER, 3-TIER) & MVC

Overview

- Data Independence in Relational Databases
- N-tier Architectures
- Design Patterns
- The MVC Design Pattern

N-tier architectures



Significance of "Tiers"

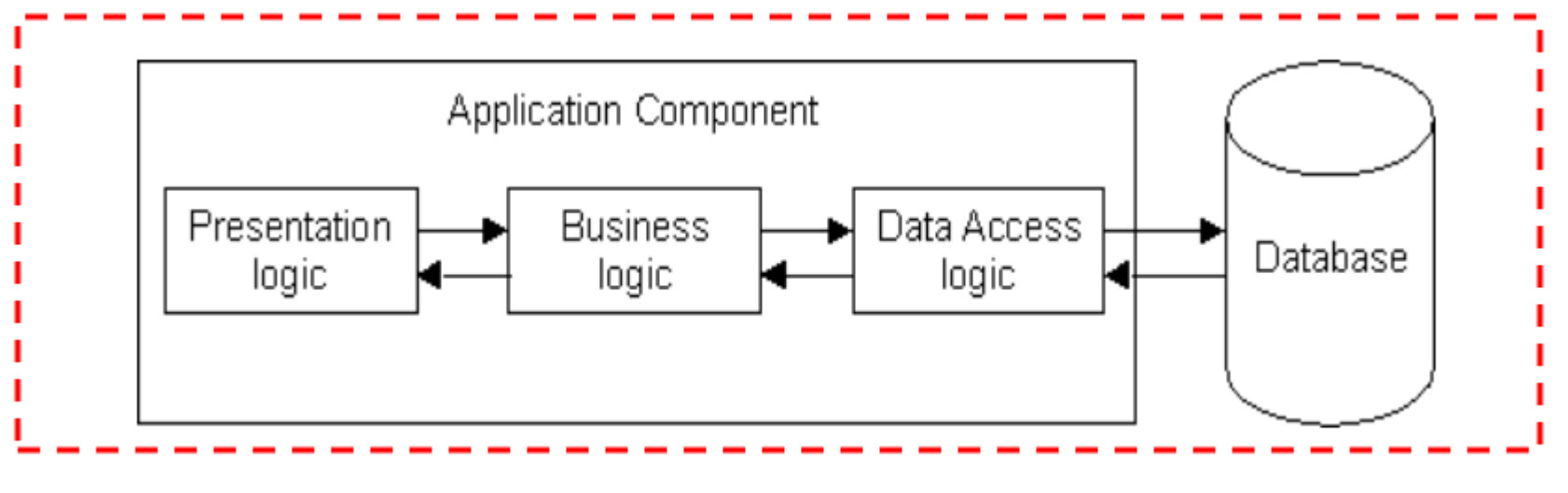
N-tier architectures have the same components

- Presentation
- Business/Logic
- Data

N-tier architectures try to separate the components into different tiers/layers

- Tier: physical separation
- Layer: logical separation

Significance of "Tiers"



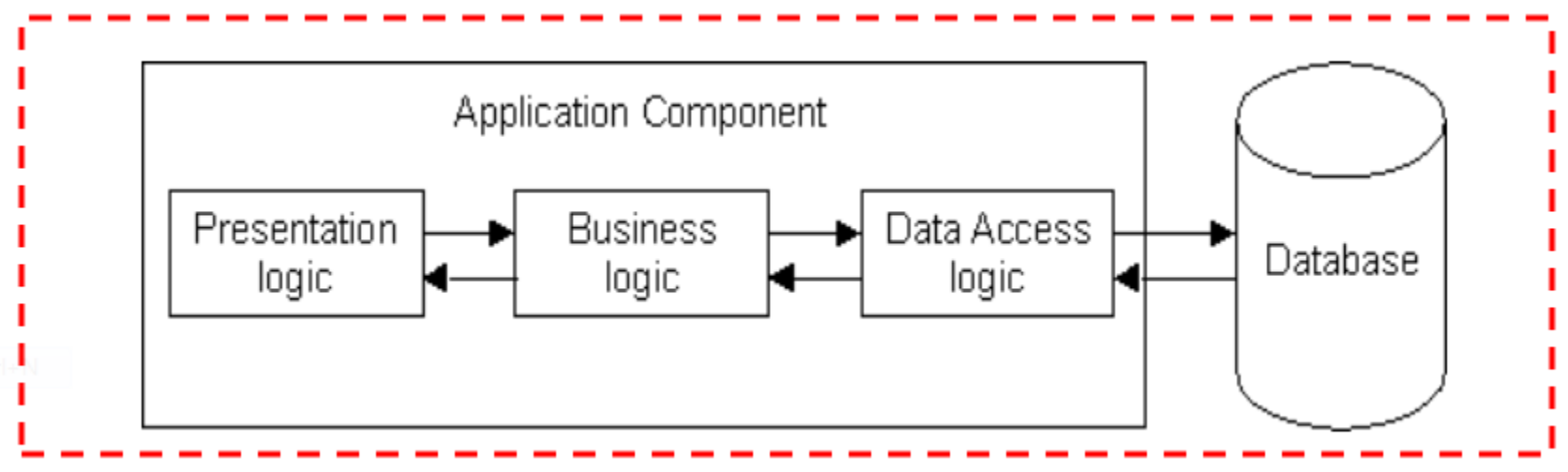
Database runs on Server

- Separated from client
- Easy to switch to a different database

Presentation and logic layers still tightly connected

- Heavy load on server
- Potential congestion on network
- Presentation still tied to business logic

1-Tier Architecture



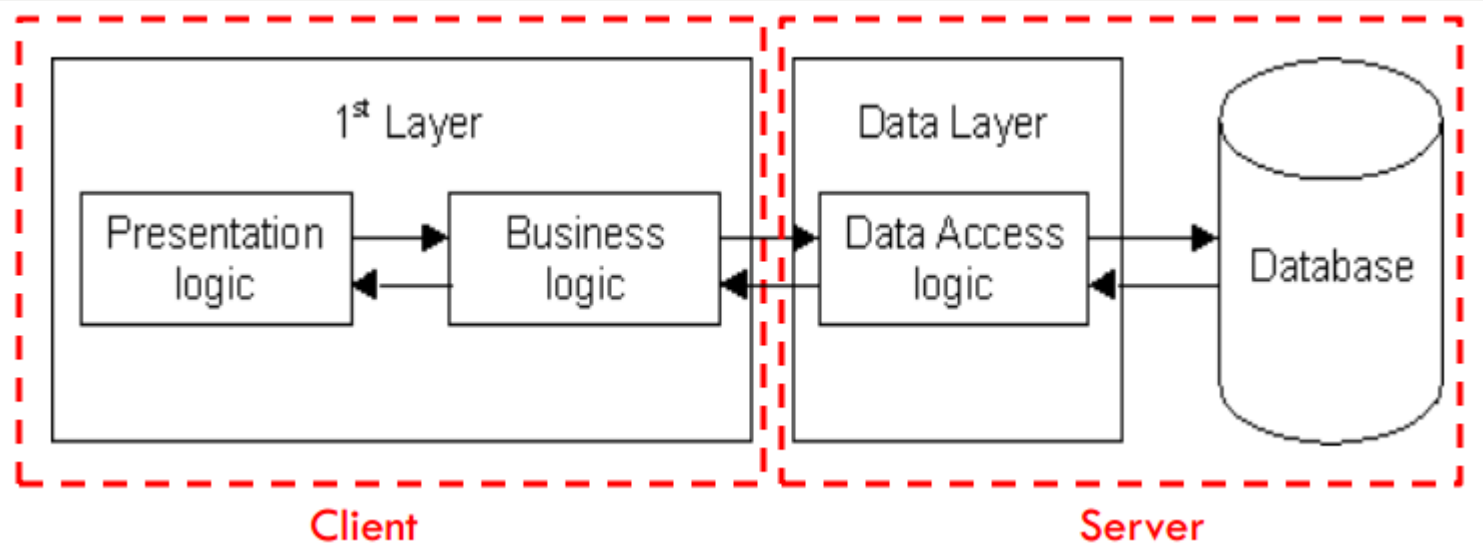
All 3 layers are on the same machine

- All code and processing kept on a single machine

Presentation, Logic, Data layers are tightly connected

- Scalability: Single processor means hard to increase volume of processing
- Portability: Moving to a new machine may mean rewriting everything
- Maintenance: Changing one layer requires changing other layers

2-Tier Architecture



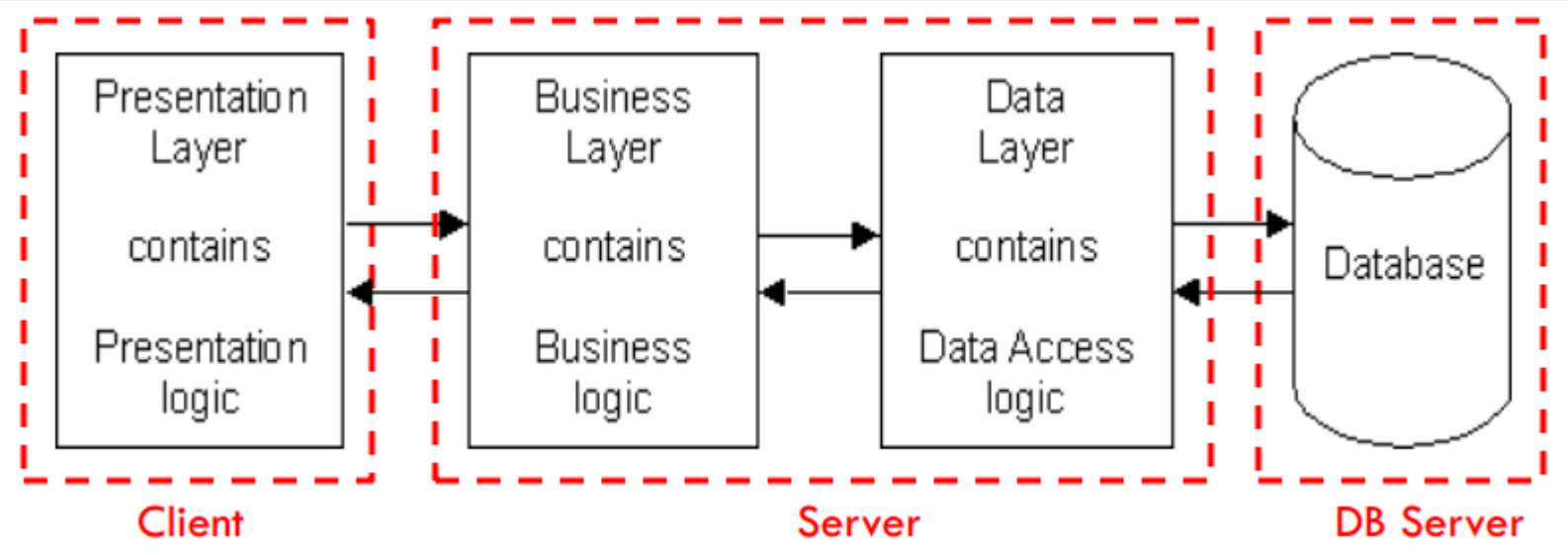
Database runs on Server

- Separated from client
- Easy to switch to a different database

Presentation and logic layers still tightly connected (coupled)

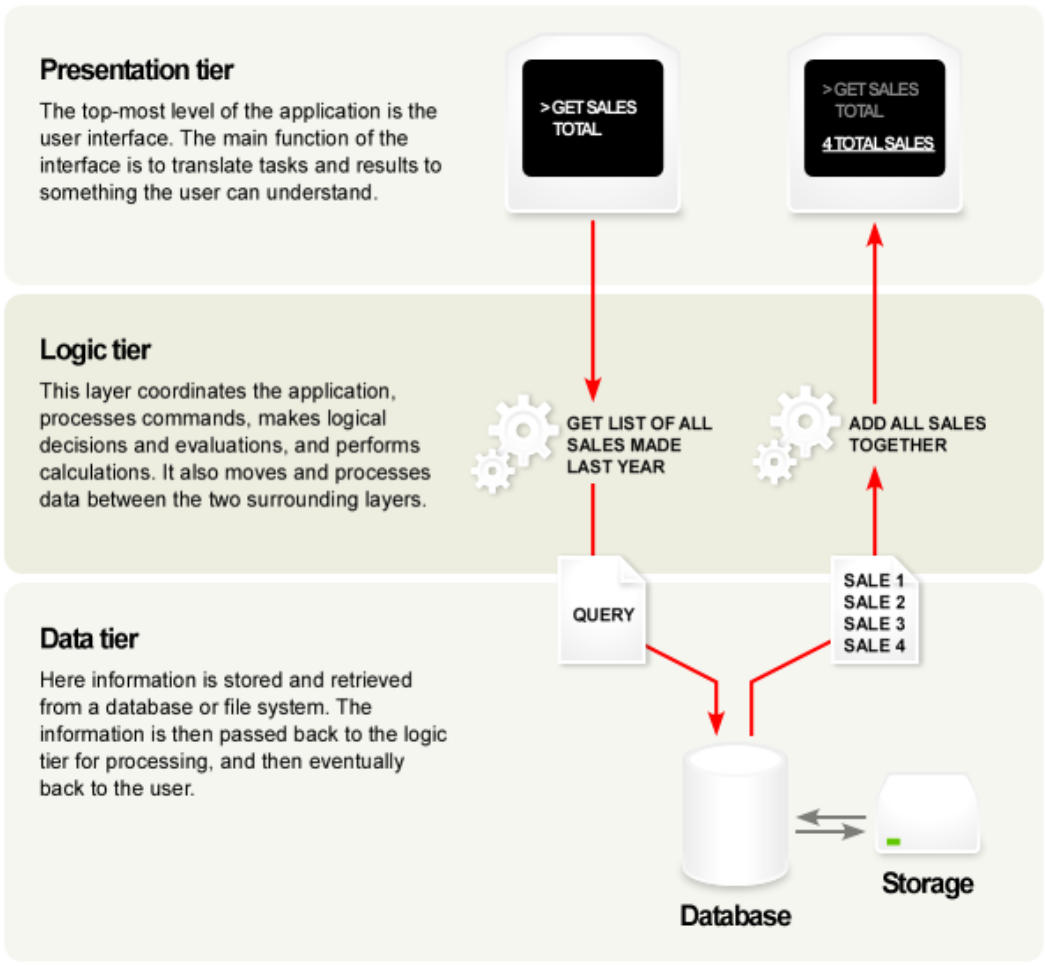
- Heavy load on server
- Potential congestion on network
- Presentation still tied to business logic

3-Tier Architecture



- Each layer can potentially run on a different machine
- Presentation, logic, data layers disconnected

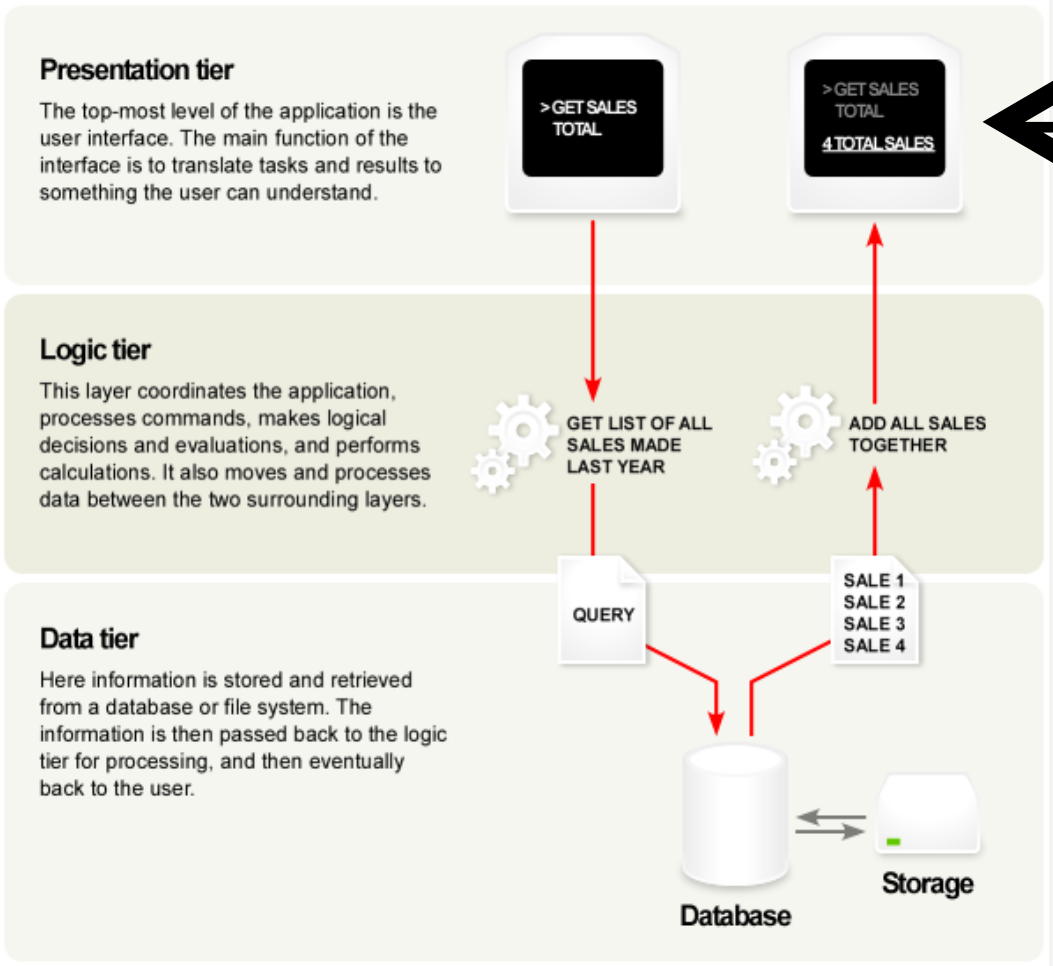
A Typical 3-tier Architecture



Architecture Principles

- Client-server architecture
- Each tier (Presentation, Logic, Data) should be independent and should not expose dependencies related to the implementation
- Unconnected tiers should not communicate
- Change in platform affects only the layer running on that particular platform

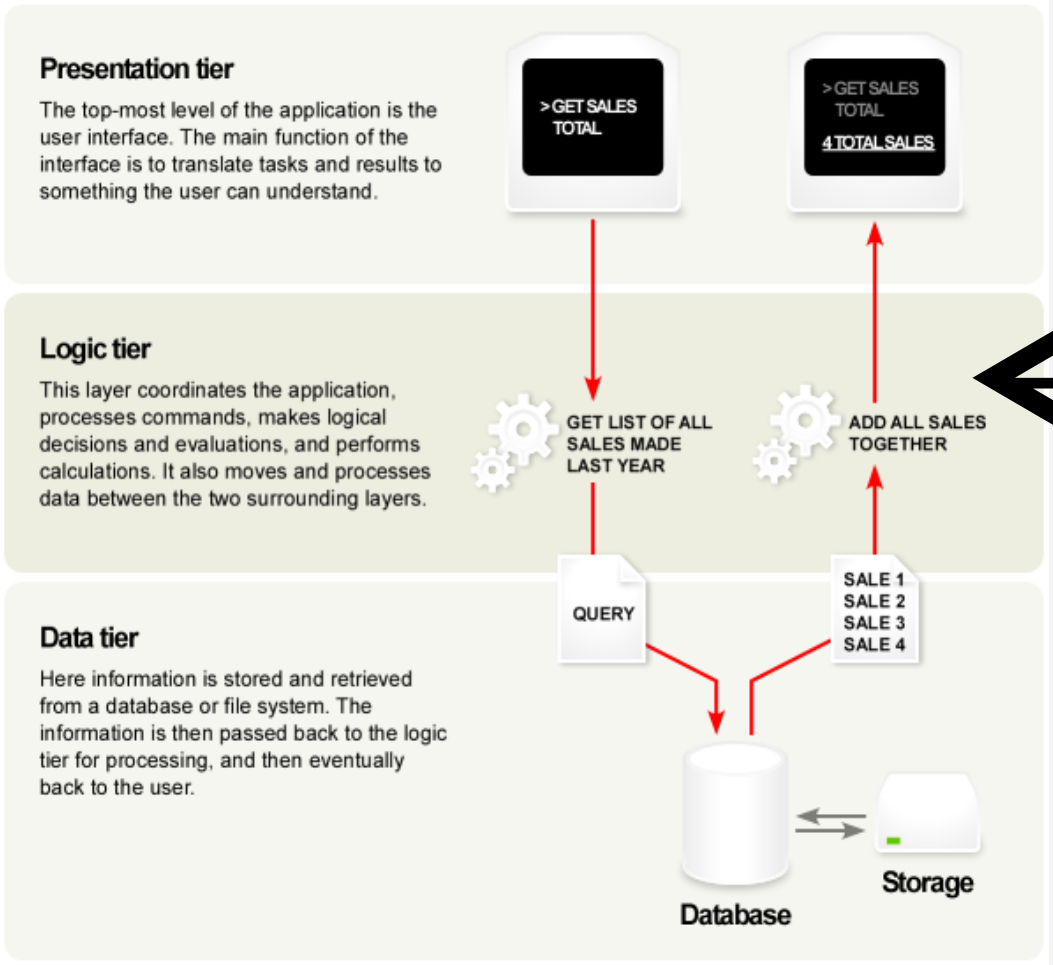
A Typical 3-tier Architecture



Presentation Layer

- Provides user interface
- Handles the interaction with the user
- Sometimes called the GUI or client view or front-end
- Should not contain business logic or data access code

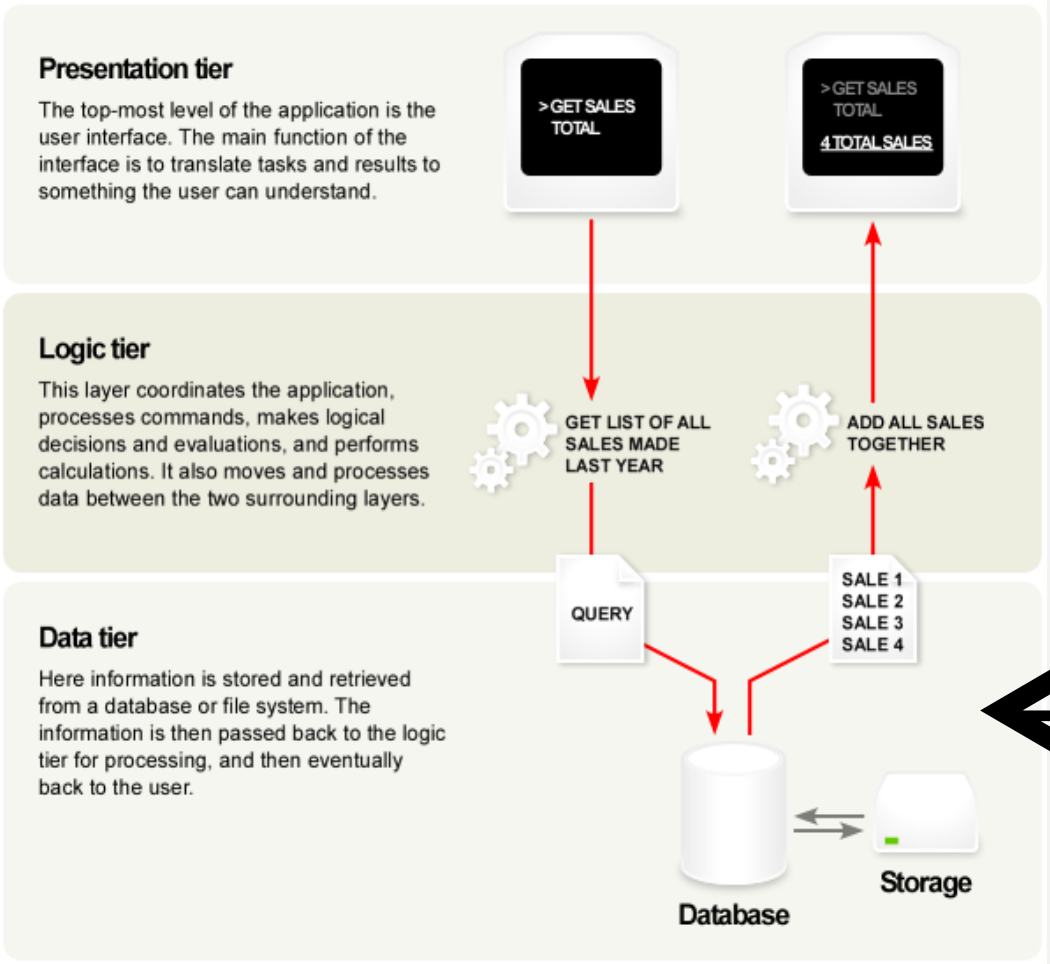
A Typical 3-tier Architecture



Logic Layer

- The set of rules for processing information
- Can accommodate many users
- Sometimes called middleware/ back-end
- Should not contain presentation or data access code

A Typical 3-tier Architecture



Data Layer

- The physical storage layer for data persistence
- Manages access to DB or file system
- Sometimes called back-end
- Should not contain presentation or business logic code

The 3-Tier Architecture for Web Apps

- **Presentation Layer**
  Static or dynamically generated content rendered by the browser (front-end)

- **Logic Layer**
  A dynamic content processing and generation level application server, e.g., Java EE, ASP.NET, PHP, ColdFusion platform (middleware)

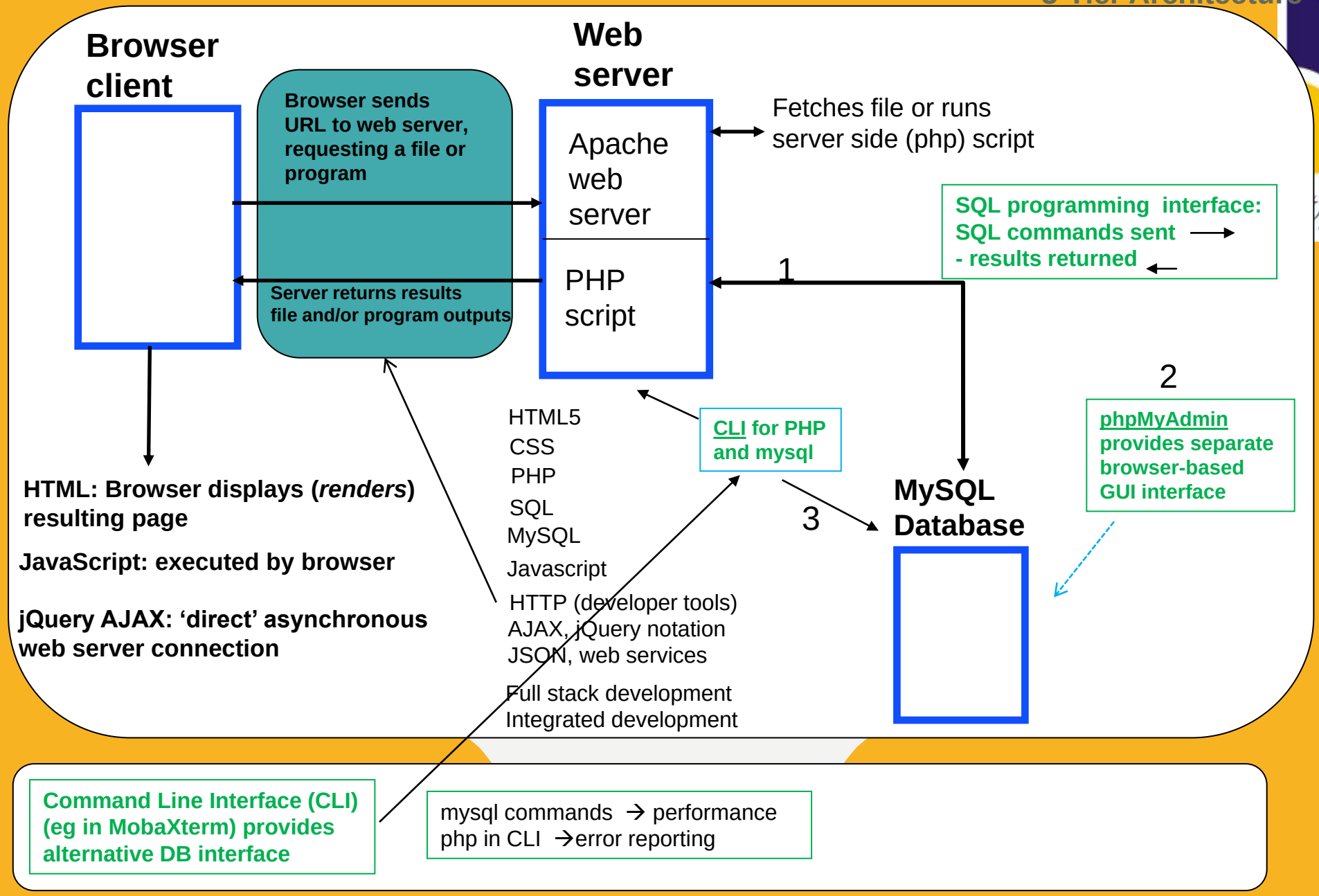
- **Data Layer**
  A database, comprising both data sets and the database management system or RDBMS software that manages and provides access to the data (back-end)

3-Tier Architecture - Advantages

Independence of Layers

- Easier to maintain
- Components are reusable
- Faster development (division of work)
  - Web designer does presentation
  - Software engineer does logic
  - DB admin does data model

Run as slide show to see animated display.



MVC DESIGN PATTERN

INTRODUCTION

- **M**odel **V**iew **C**ontroller or MVC as it is popularly called, is a software design pattern for developing web applications.

- **Model–view–controller** (**MVC**) is a software architecture pattern which separates the representation of information from the user's interaction with it .

- **ASP.Netm Angular js, Ruby on rails**

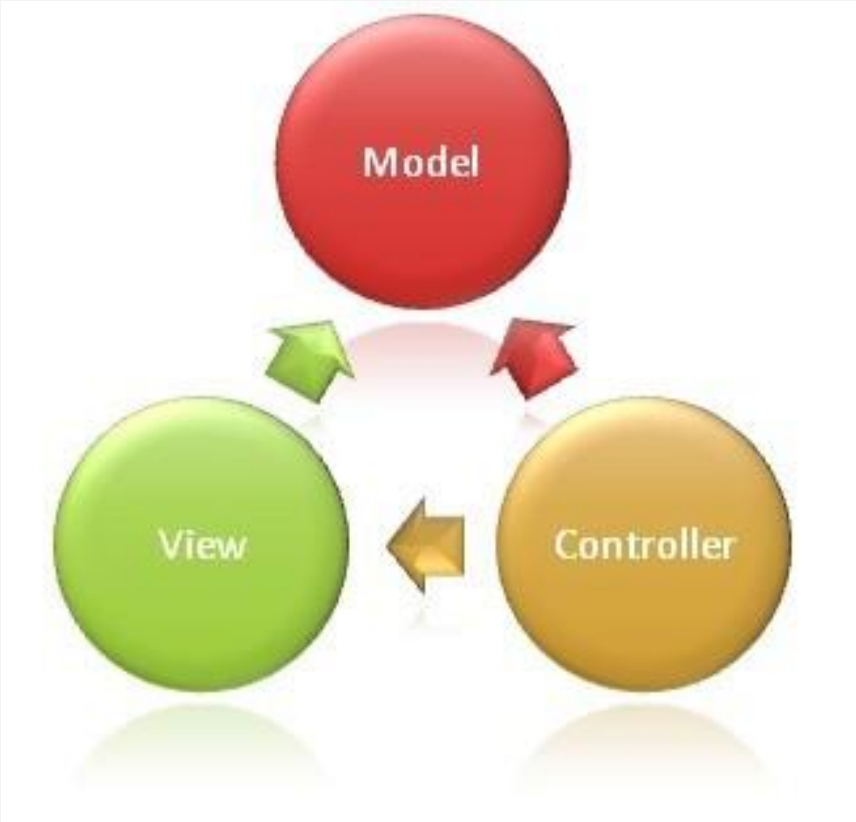
HISTORY OF MVC

- Presented by Trygve Reenskaug in 1979

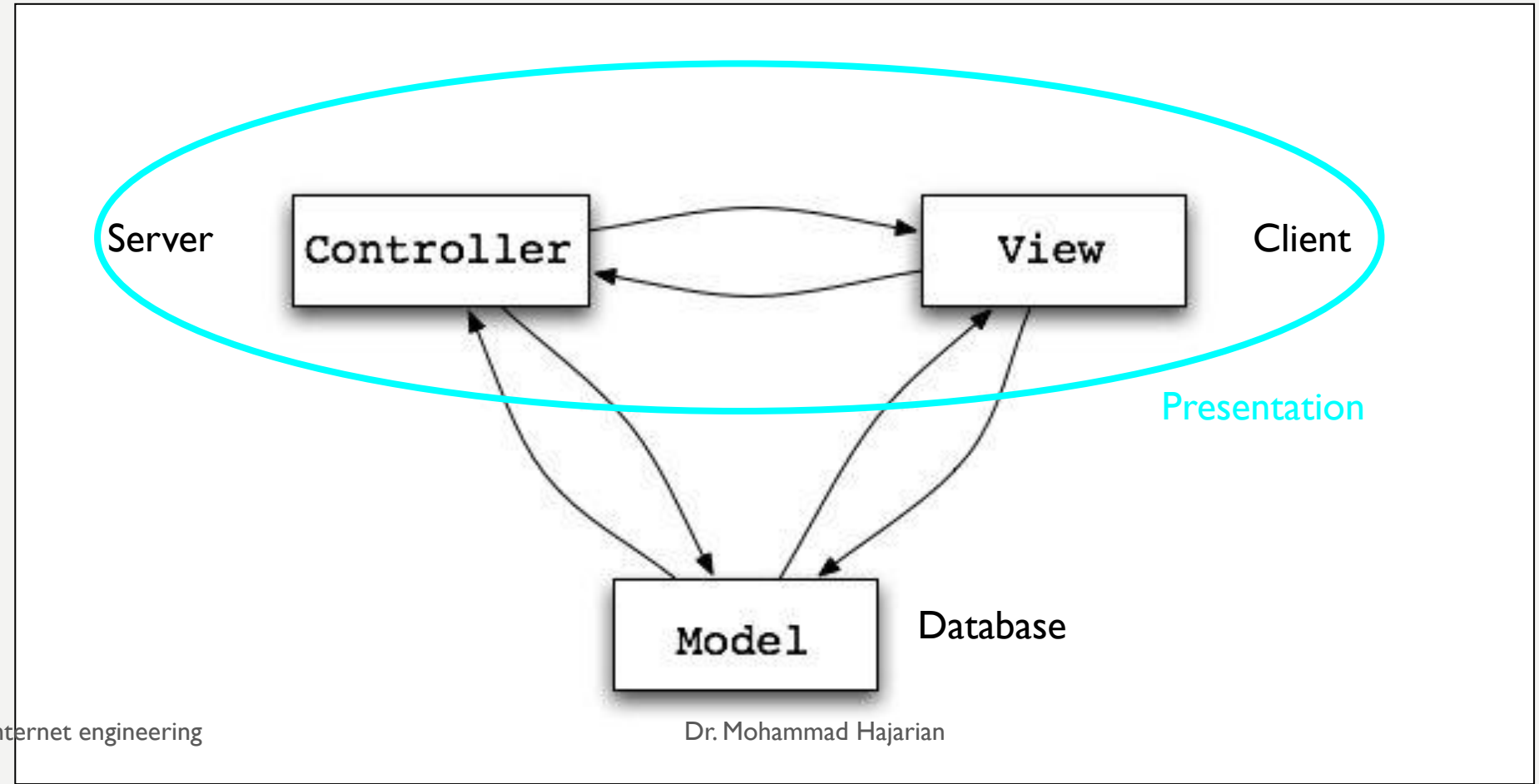
- First used in the Smalltalk-80 framework
  - Used in making Apple interfaces (Lisa and Macintosh

Parts of MVC

- A Model View Controller pattern is made up of the following three parts:
- **Model**
- **View**
- **Controller**



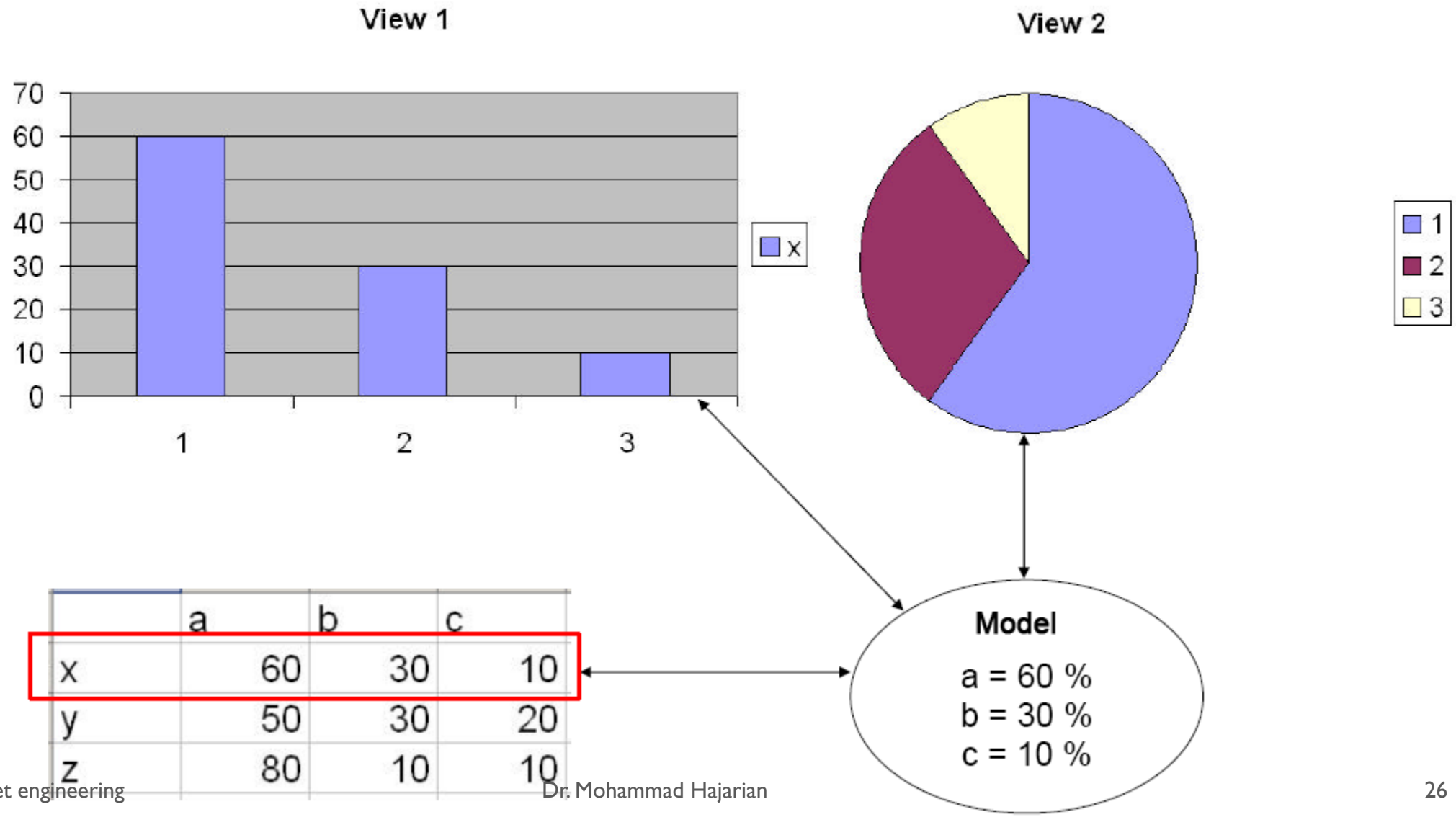
- Presentation:
  - View is the user interface (e.g. button)
  - Controller is the code (e.g. callback for button)
- Data:
  - Model is the database



EXAMPLE CONTROL FLOW IN MVC

- User interacts with the VIEW UI
- CONTROLLER handles the user input (often a callback function attached to UI elements)
- CONTROLLER updates the MODEL
- VIEW uses MODEL to generate new UI
- UI waits for user interaction

MVC – GENERAL EXAMPLE



ADVANTAGES

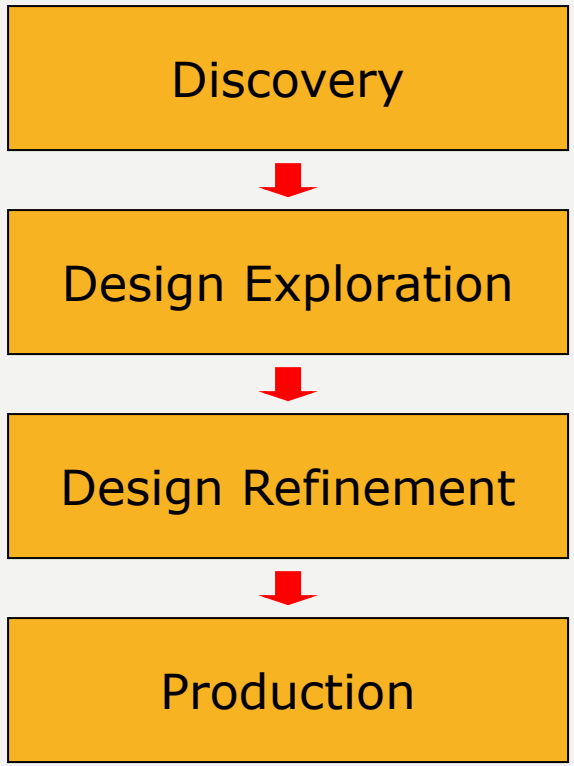
- Clear separation between presentation logic and business logic.
- Each object in mvc have distinct responsibilities.
- parallel development
- easy to maintain and future enhancements
- All objects and classes are independent of each other.

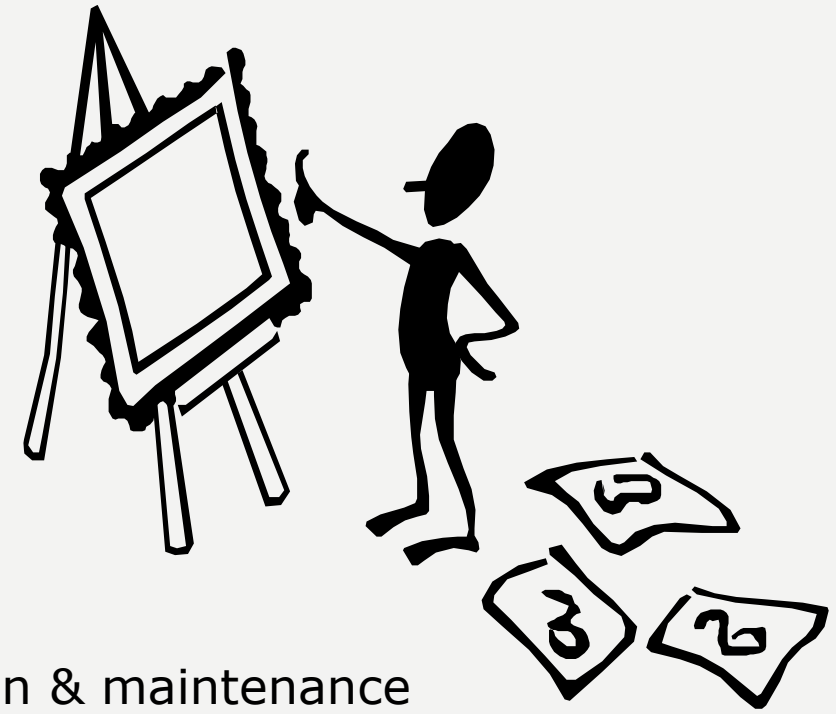
DISADVANTAGES

- Increased complexity
- Inefficiency of data access in view
- Difficulty of using MVC with modern user interface too.
- For parallel development there is a needed multiple programmers.
- Knowledge on multiple technologies is required.

INTERACTION DESIGN

WEBSITE DESIGN PROCESS

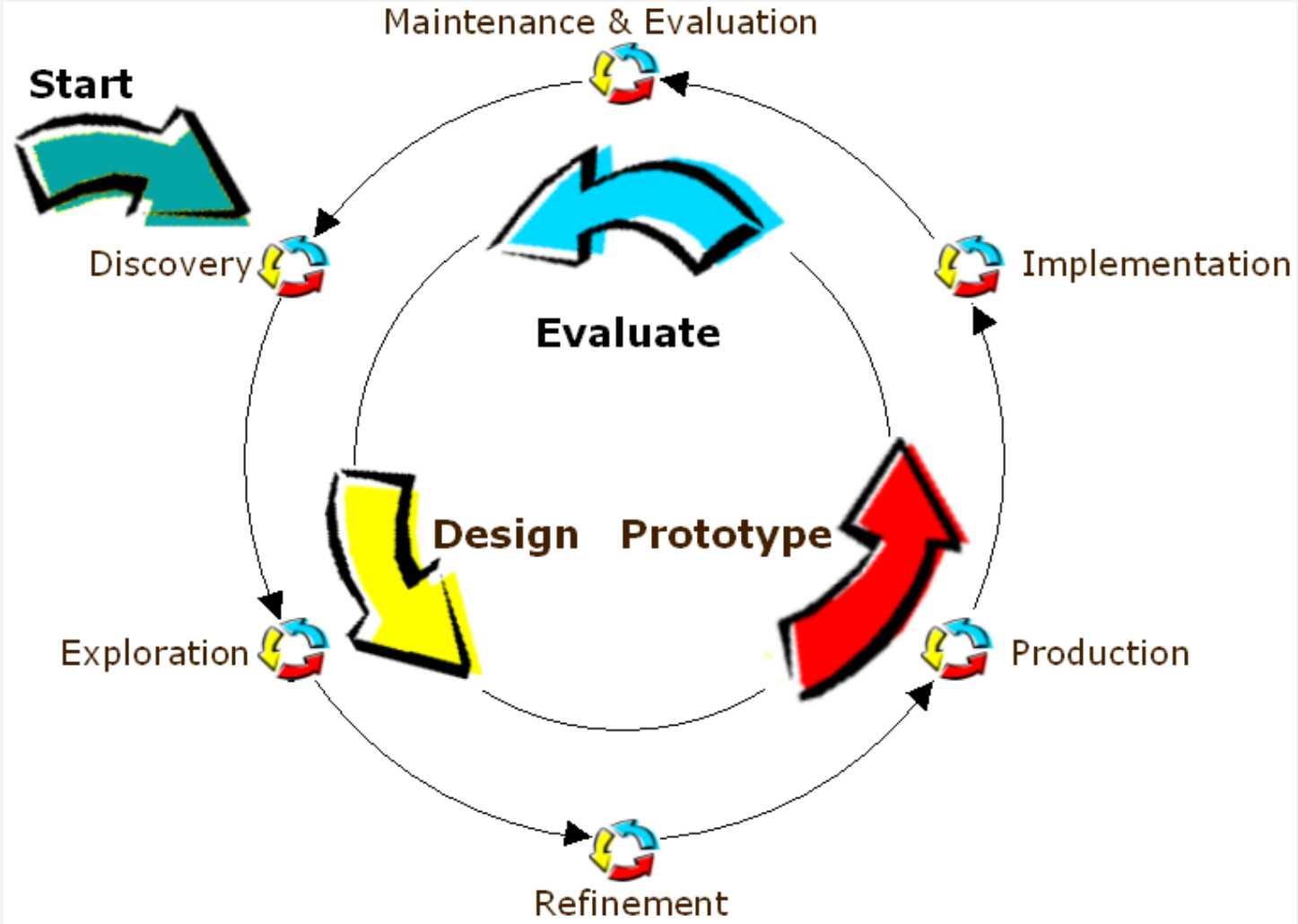




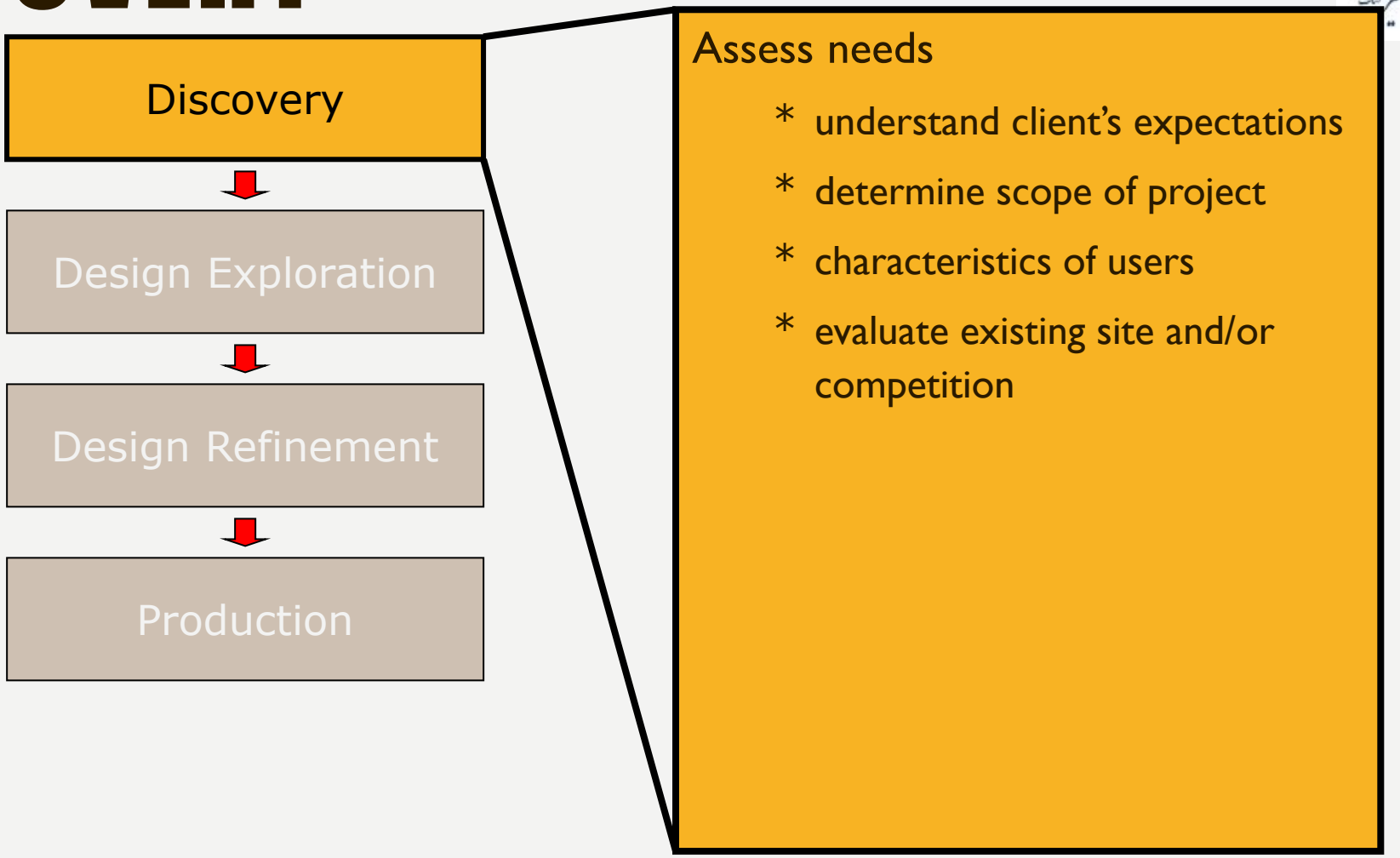
… followed by implementation & maintenance

[this set of slides from James Landay]

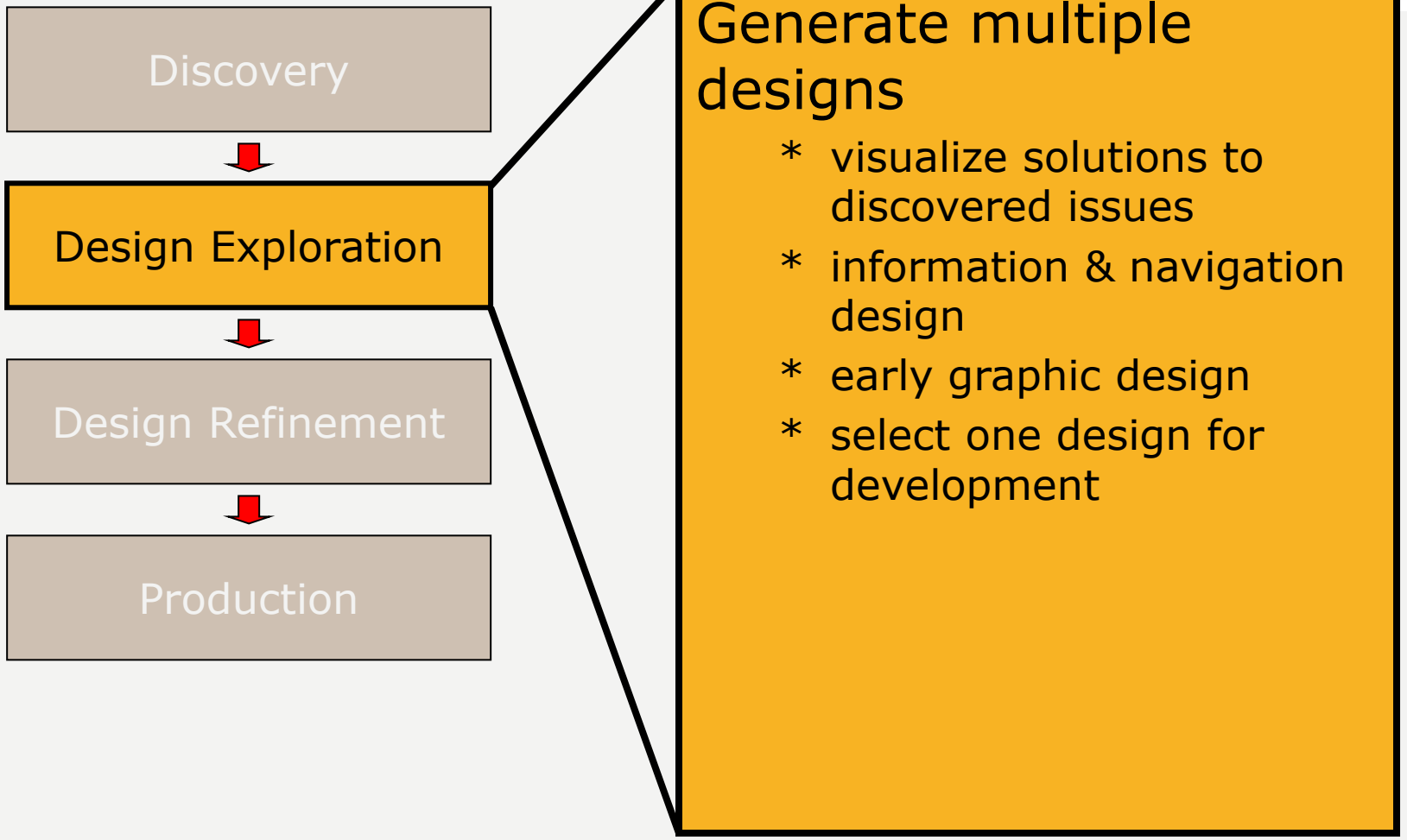
WEB DESIGN PROCESS



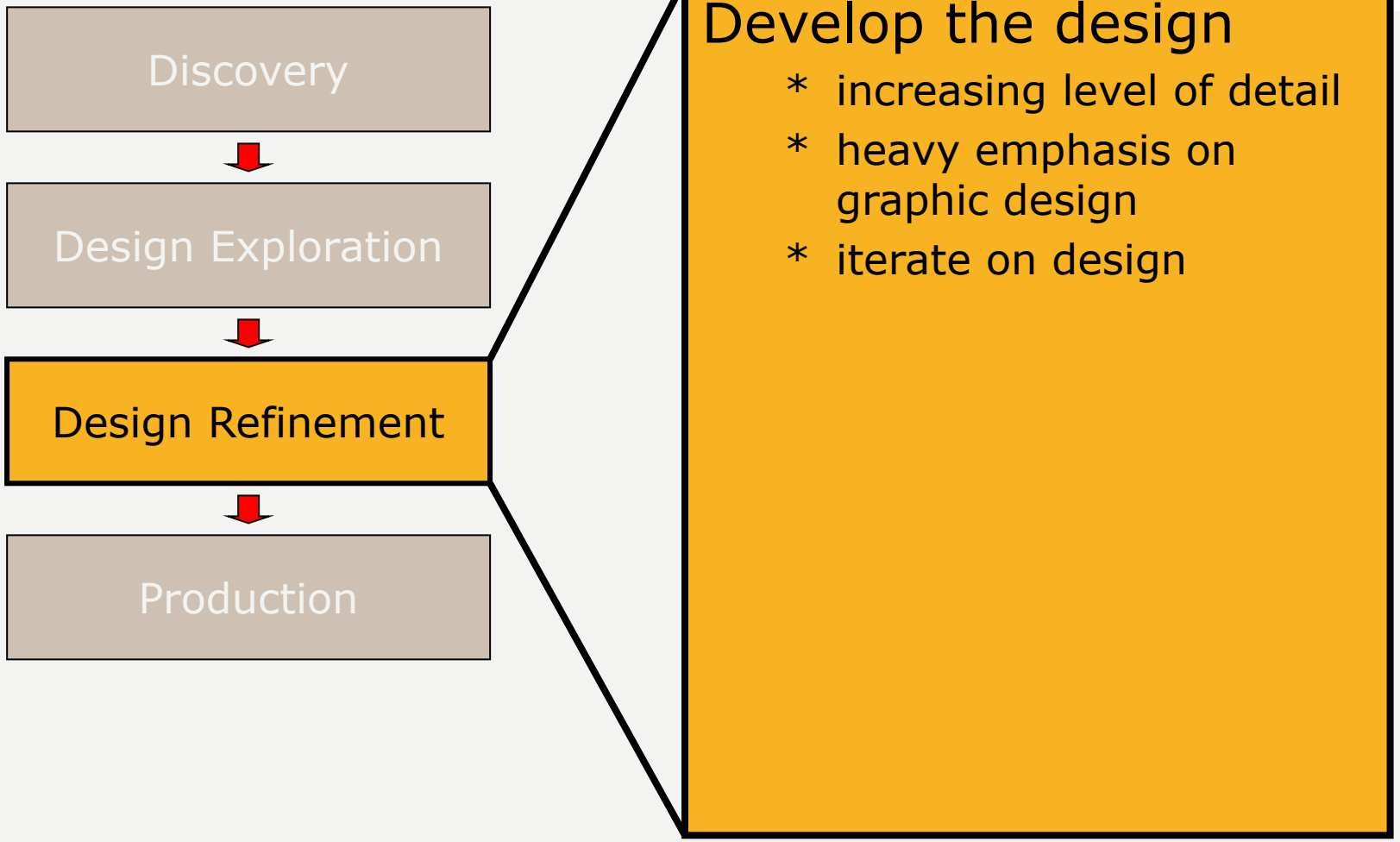
DESIGN PROCESS: DISCOVERY



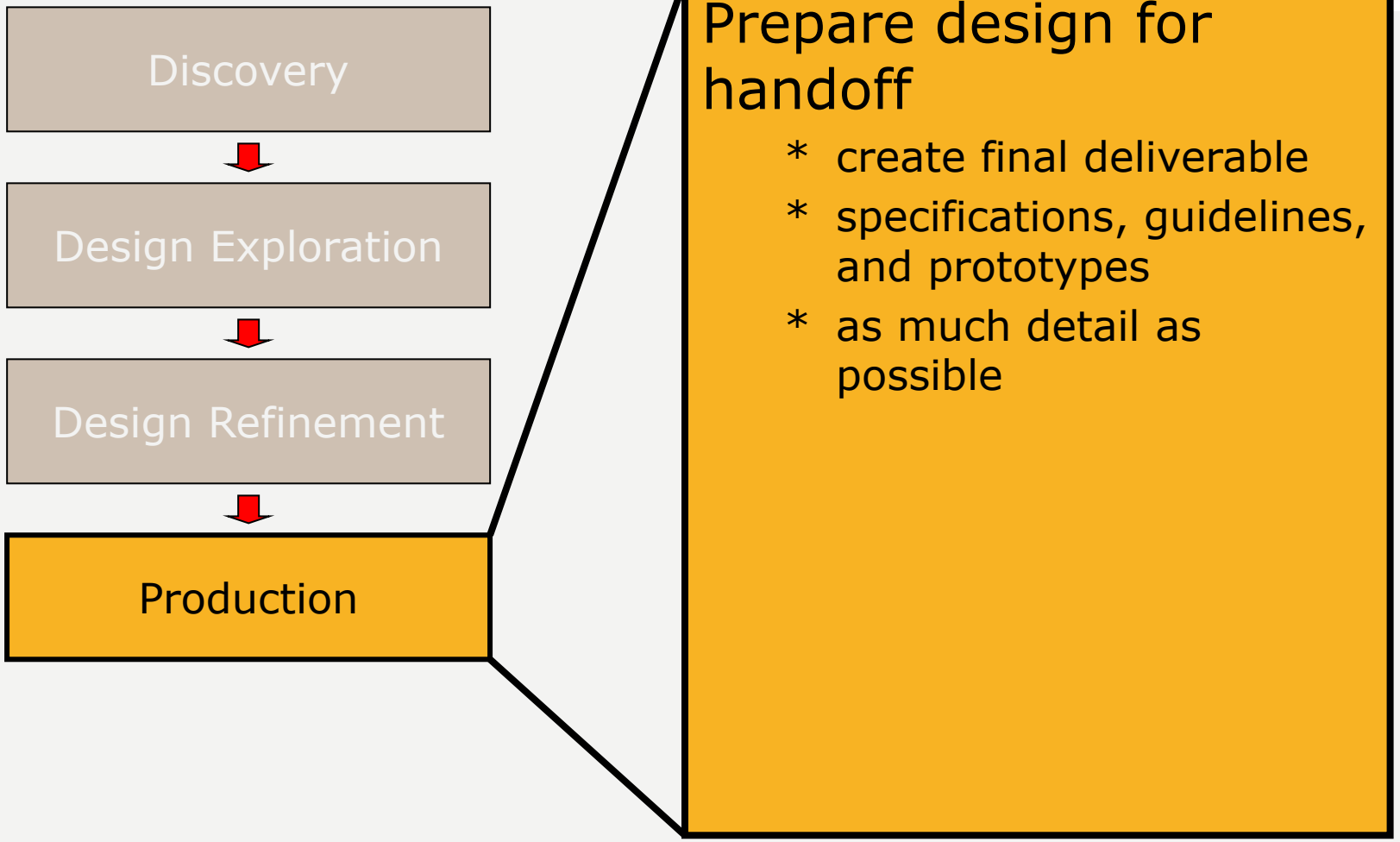
DESIGN PROCESS: DESIGN EXPLORATION



DESIGN PROCESS: DESIGN REFINEMENT



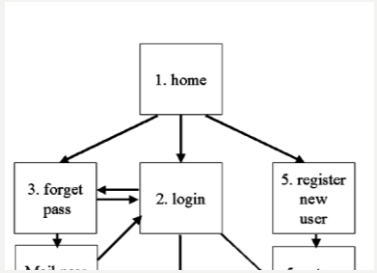
DESIGN PROCESS: PRODUCTION



ARTIFACTS OF DESIGN PRACTICE

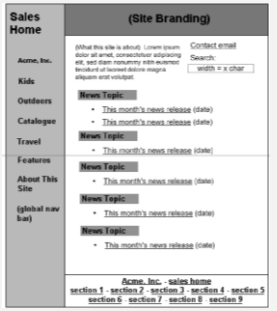
- Designers create representations of sites at *multiple levels of detail*
- Web sites are iteratively refined at all levels of detail

Site Maps

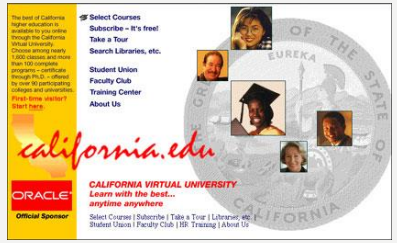


Storyboards

Schematics

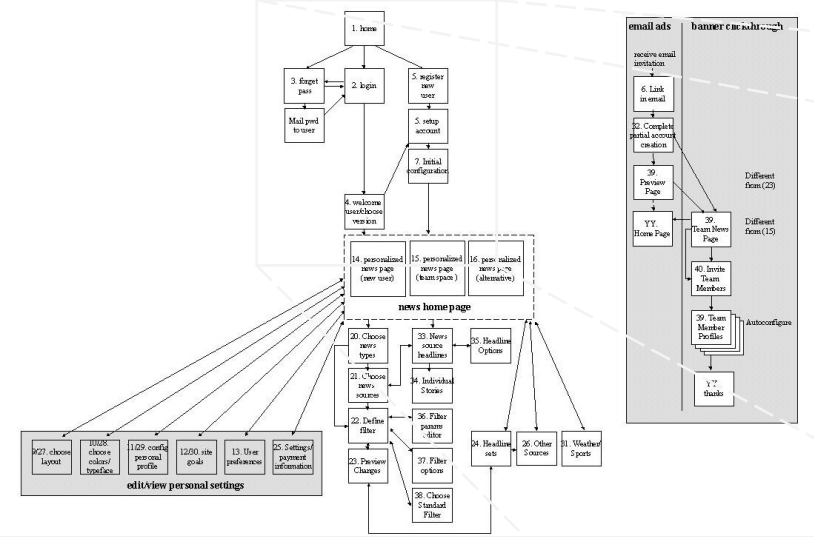


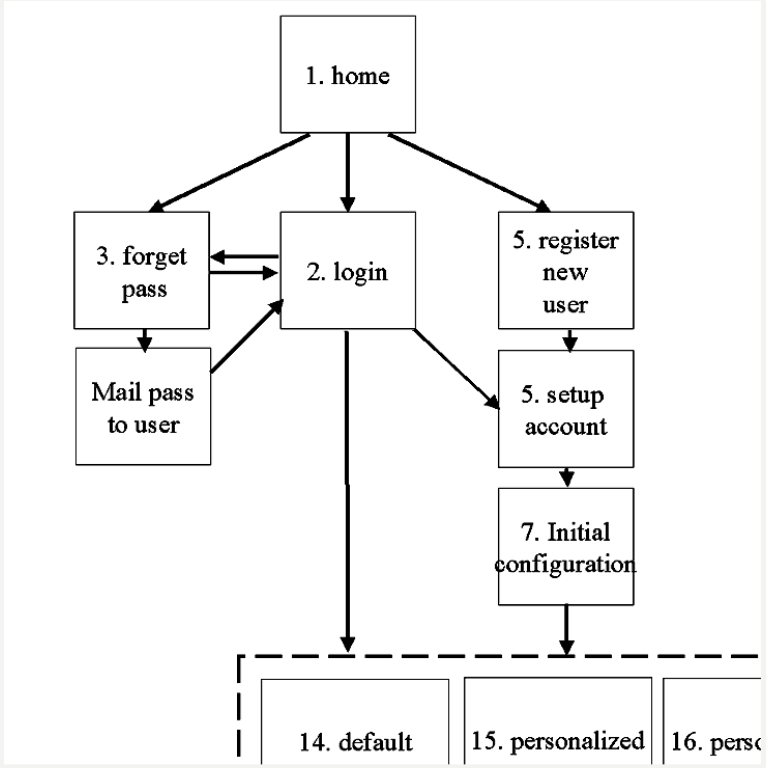
Mock-ups



SITE MAPS

- High-level, coarse-grained view of entire site



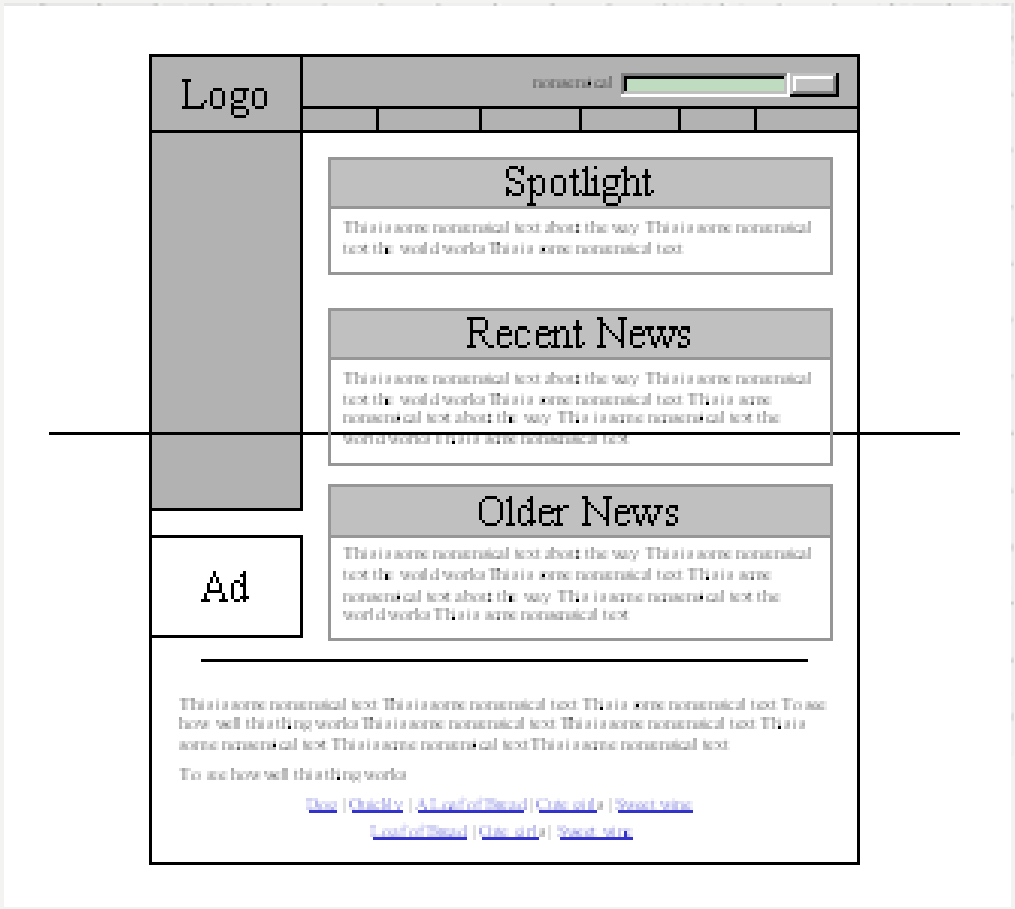


STORYBOARDS

- Interaction sequence, minimal page level detail

SCHEMATICS

- Page structure with respect to information & navigation



MOCK-UPS

- High-fidelity, precise representation of page

WHAT MAKES A WEBSITE GOOD?

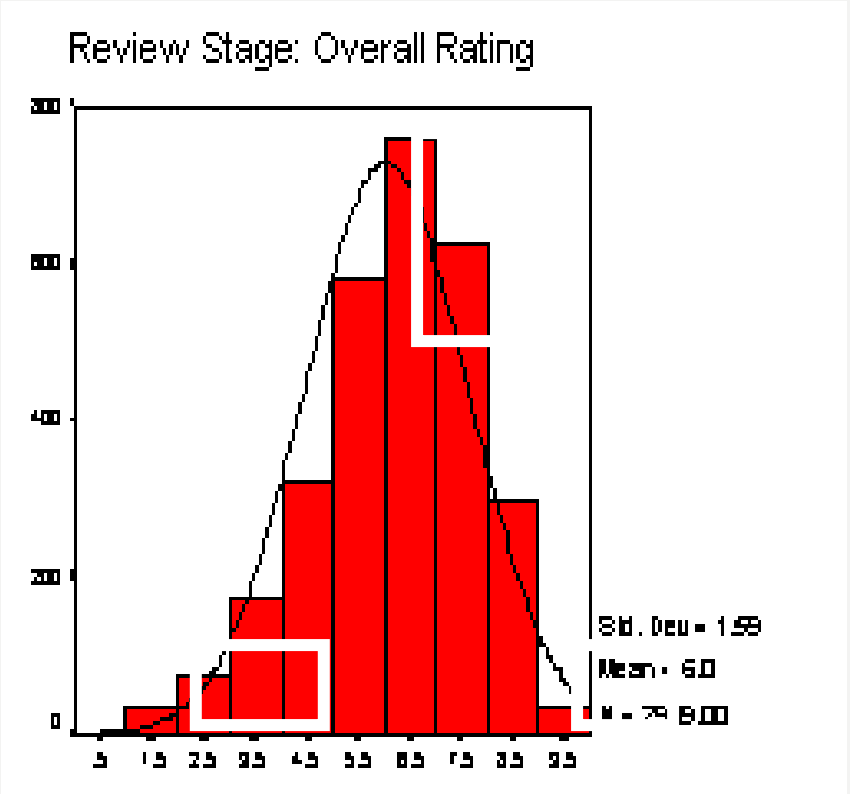
- Graphic design?
- Design criteria?
- Subjective

WEBBY AWARDS

- www.webbyawards.com
- "international award honoring excellence in Web design, creativity, usability and functionality"
- 500 judges, 6 criteria, 65 categories
- 5500 entries

WEBBY AWARDS

- 6 criteria
  - Content
  - Structure & navigation
  - Visual design
  - Functionality
  - Interactivity
  - Overall experience
- Scale: 1–10 (highest)
- Nearly normally distributed



WEBBY AWARDS CRITERIA

- Content = information provided
  - engaging, relevant
  - clear, concise
- Structure and Navigation = framework and organization of site
  - consistent, intuitive, transparent
  - facilitates forming mental model of information
- Visual Design
  - high quality, relevant, communicates visual experience, doesn't have to be trendy

WEBBY AWARDS CRITERIA

- Functionality = how site works
  - loads quickly, live links, browser independent
  - experience center stage, technology invisible
  - accessibility
- Interactivity = way the site allows you to do something
  - users participate, not spectate
- Overall Experience
  - intangibles that make one stay or leave, place bookmark, sign up for newsletter, participate

ANALYSIS OF JUDGING CRITERIA

- Statistical analysis applied to corpus of Webby Awards data
- Attribute most highly correlated with winning:

  Functionality
- Least highly correlated:

  Graphic design

USABILITY

- Usability is a "quality attribute" that assesses how easy user interfaces are to use. Five components:
  - Learnability - how easy it is for users to accomplish tasks the first time they encounter the design
  - Efficiency - how quickly can users perform tasks
  - Memorability - when users return, how easily do they reestablish proficiency
  - Errors - how many errors users make, how severe, how easy to recover from errors
  - Satisfaction - how pleasant design is to use

USER-CENTERED DESIGN

- User-centric, not data-centric
  - Observe users
  - Enlist help of expert users
  - Personas
- Interdisciplinary
  - Art
  - Psychology
  - Technical writing
  - Computer science
- Interactive
  - Multiple iterations
  - Testing
  - Revision

USER-CENTERED DESIGN PROCESS

- Needs Analysis
- User and Task Analysis
- Functional Analysis
- Requirements Analysis
- Setting Usability Specifications
- Design
- Prototyping
- Evaluation

GUIDELINES FOR HOME PAGE USABILITY

- Make site's purpose clear
  - Explain who you are and what you do
  - One sentence tagline
  - Window title with good visibility in search engines and bookmark lists
- Help users find what they need
  - Clear starting point for high-priority tasks
  - Search box if your website is large

[Nielsen, 2006]

GUIDELINES FOR HOME PAGE USABILITY

- Reveal site content
  - Show examples
  - Begin links with important keywords
  - Easy access to recent features
- Visuals should enhance, not clutter your site
  - Studies show people look at text on web sites, not images
  - Users often dismiss graphics as ads and ignore

[Nielsen, 2006]

USABILITY STUDY OF MAJOR WEB SITES

- Studied usability of 9 major web sites
  - including C|Net, Disney, HP, Fidelity, etc.
- Performed by consulting company
  - User Interface Engineering, Jared M. Spool
  - http://www.uie.com
- Data
  - "dozens" of hours of user observations
  - detailed analysis of site composition
  - task to find particular information from each site

EMPIRICAL RESULTS FROM USABILITY STUDY

- Lots of bad sites
  - home pages offered little direction on content
- "Readable" pages were less effective
  - people don't read, they skim
  - nicely formed sentences hide key information

EMPIRICAL RESULTS (CONT.)

- Download time wasn't a big issue
  - no correlation between time and frustration
- Graphic design had very little effect
  - take a look at Yahoo
  - may be important for brand, marketing, etc.
- Navigation must be linked to content
  - if not, users found sites less usable
  - forget about designing separately ("shell" sites)
    - if ½ of content or more is generic, then it is a shell site
    - generic links do not give users predictable results

EMPIRICAL RESULTS (CONT.)

- Violating the "sales script"
  - standard human-human sales situations
    - browse and then give personal info when you buy
      - employees wear name tags
  - web-based situations that violate this fail
    - users driven away by giving personal info first
    - you must first build trust!

ANIMATION

- Higher click-thru rates, but
  - annoyed users
    - scrolled, covered with hands...
    - animation makes it much harder to read/skim
- Could be useful in conveying information
  - they found no examples of this
- "Surfing" different from information retrieval
  - may not be able to design a site for both

WEBSITE DESIGN GOALS

- Usability and user-centered design
- Web readability
- Other?

HOW USERS READ ON THE WEB

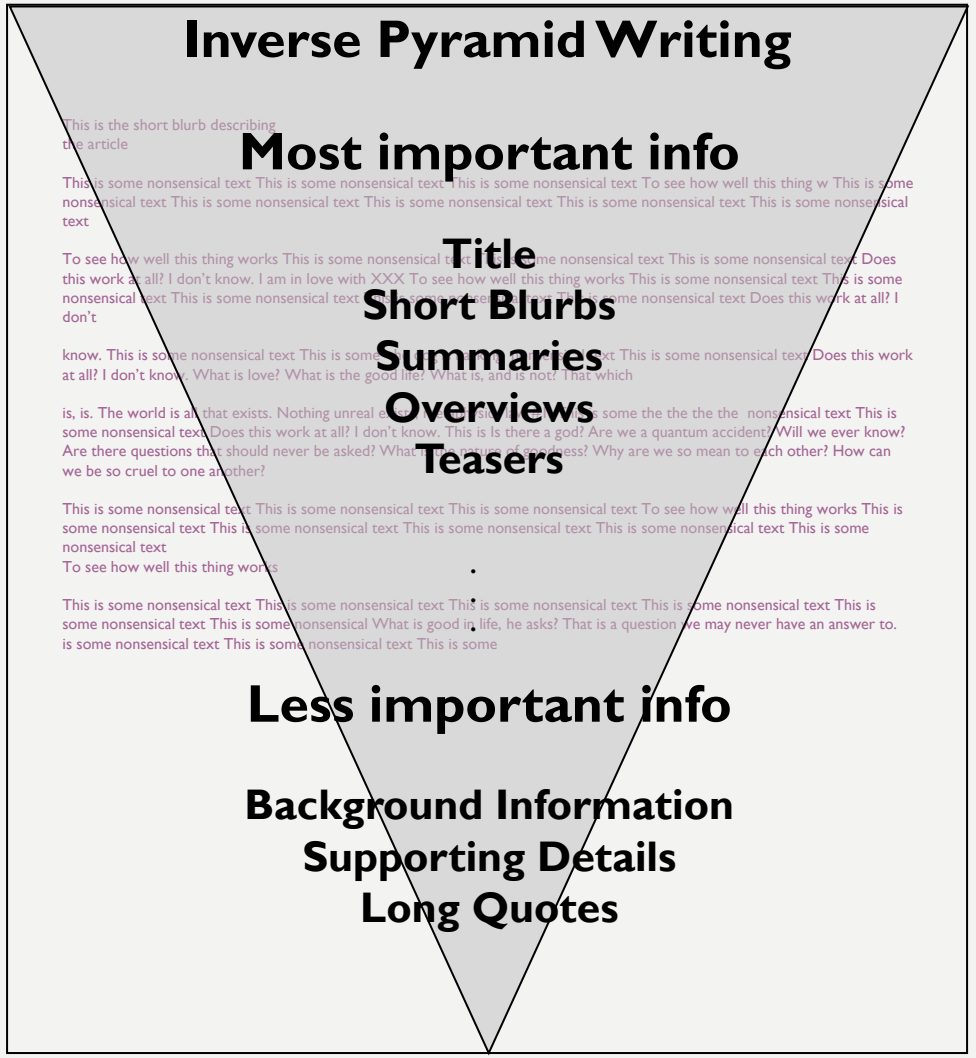
- They don't!
- Users scan rather than read
  - Nielsen and Morkes [97] found that 79% of users always scanned any new page
- Reading from computer screens is tiring and about 25% slower than reading from paper
  - High resolution monitors, better typefaces may improve this
- Information foraging [Xerox PARC]

HOW TO MAKE WEB PAGES READABLE

- Use scannable text
  - Highlighted keywords
  - Meaningful sub-headings
  - Bulleted lists
- One idea per paragraph
- Inverted pyramid style of writing (conclusion first)
- Half the word count of conventional writing
- No "marketese"
- Credibility is important

[Nielsen, 2006]

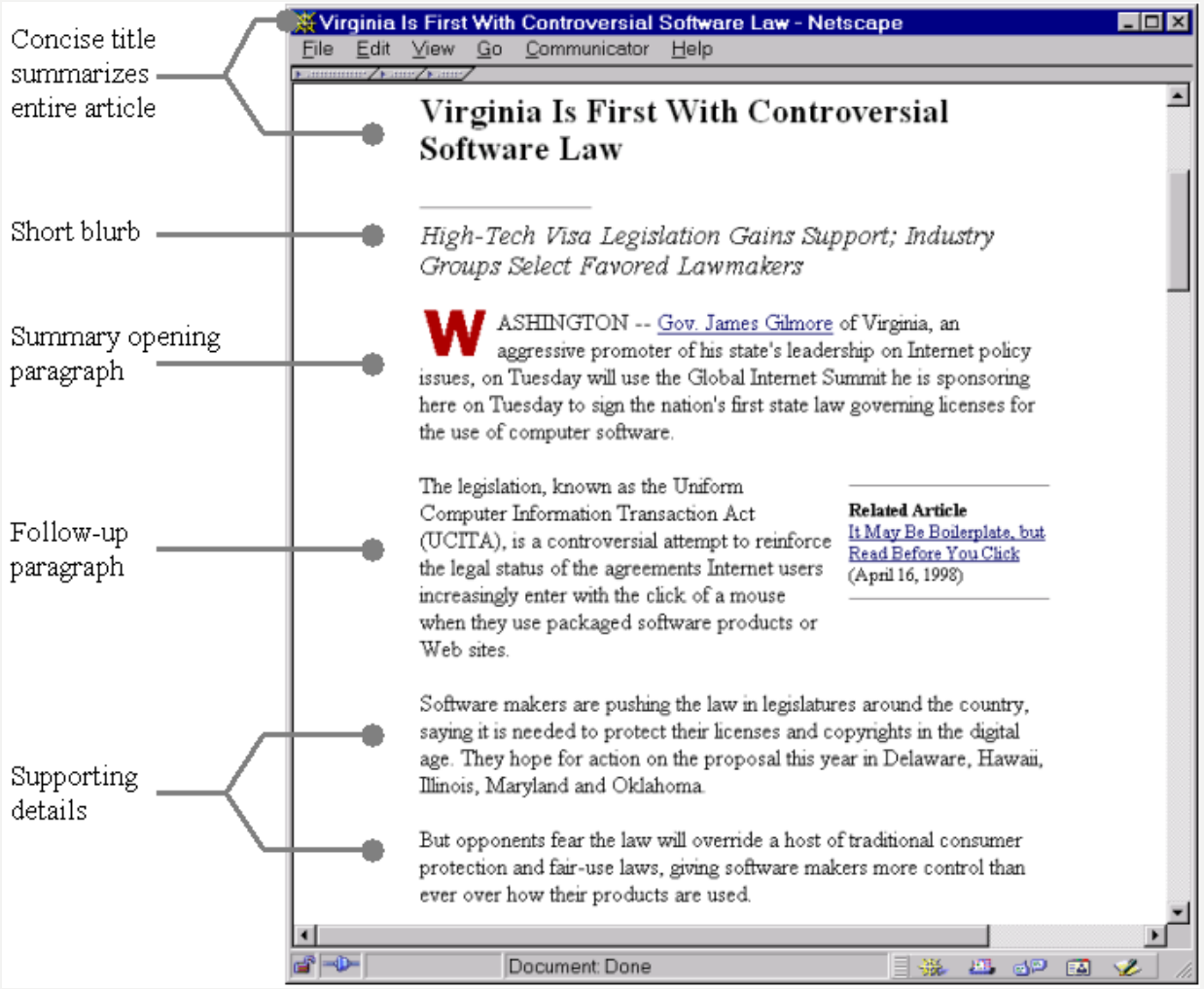
Inverse Pyramid Writing Style



[Landay 2002]

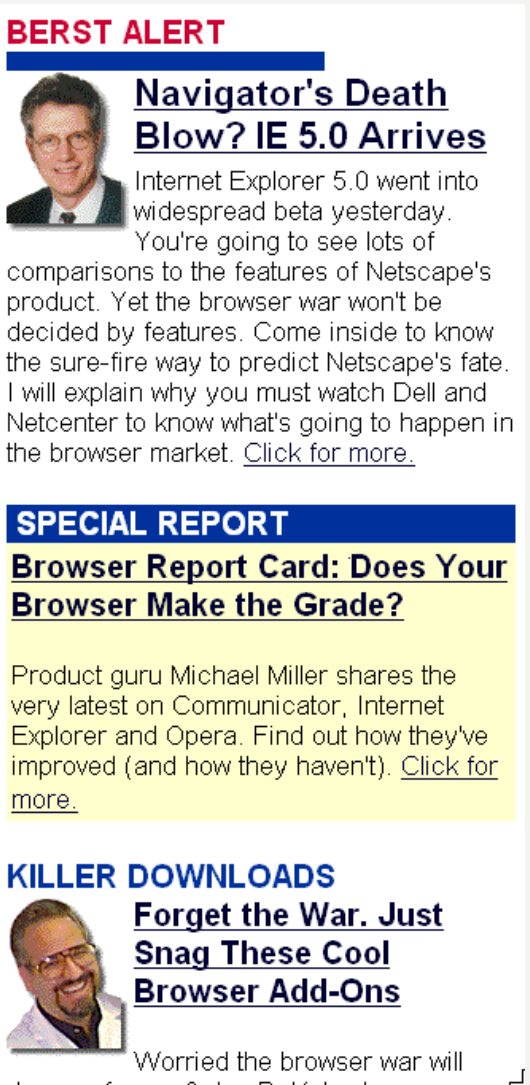
JOURNALISTS USE INVERTED PYRAMID

from
www.nytimes.com



[Landay 2002]

ZDNET USES INVERTED PYRAMID



BERST ALERT

Navigator's Death Blow? IE 5.0 Arrives

Internet Explorer 5.0 went into widespread beta yesterday. You're going to see lots of comparisons to the features of Netscape's product. Yet the browser war won't be decided by features. Come inside to know the sure-fire way to predict Netscape's fate. I will explain why you must watch Dell and Netcenter to know what's going to happen in the browser market. Click for more.

SPECIAL REPORT

Browser Report Card: Does Your Browser Make the Grade?

Product guru Michael Miller shares the very latest on Communicator, Internet Explorer and Opera. Find out how they've improved (and how they haven't). Click for more.

KILLER DOWNLOADS

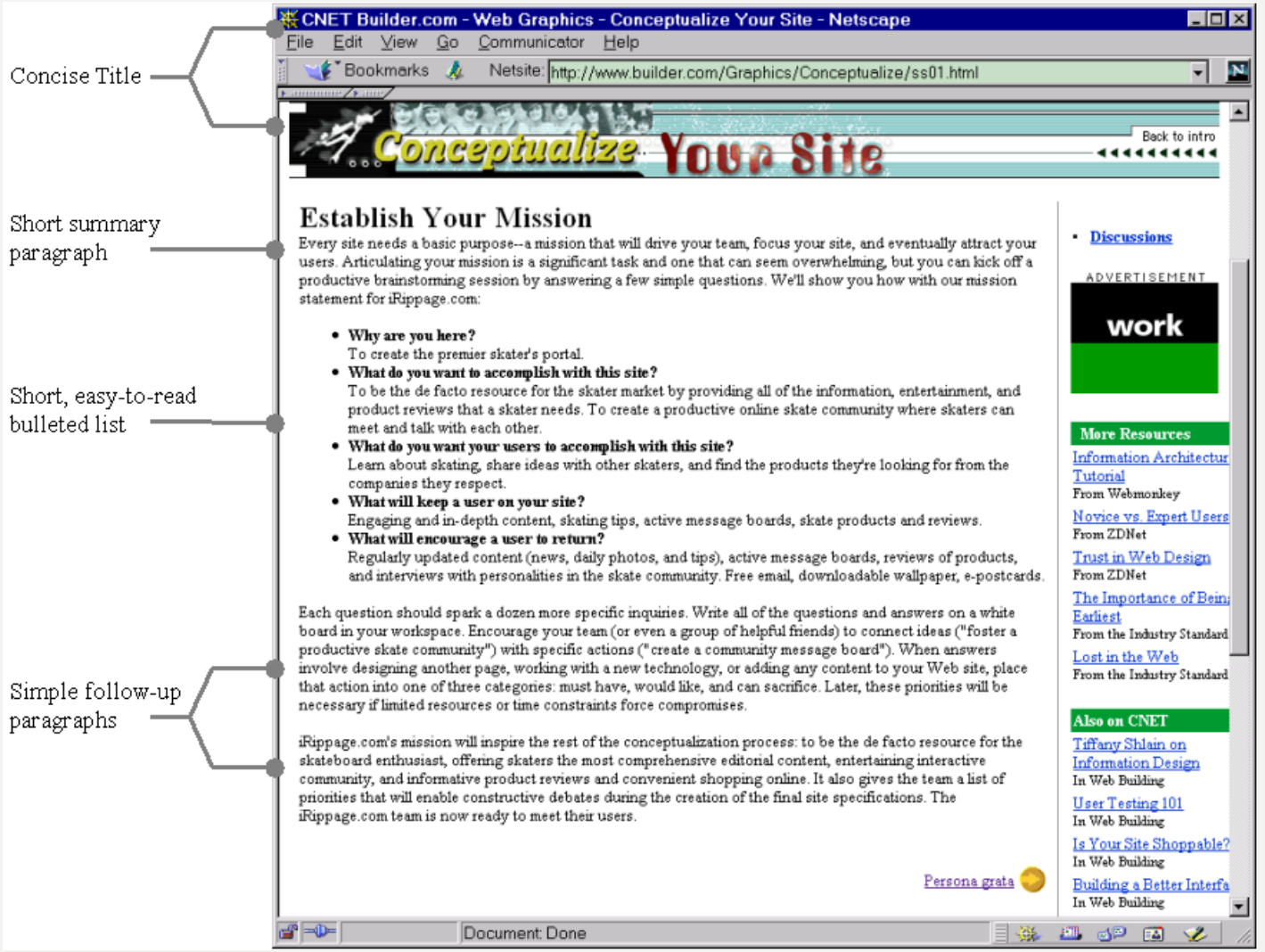
Forget the War. Just Snag These Cool Browser Add-Ons

Worried the browser war will

- Start with a good concise title
  - reflect the content
- Continue with the most important points
  - use hypertext to split up information
  - people often won't scroll or read
- Use less text
  - 50% less than you would offline
- Use a simple writing style
  - simple sentences -- no hype or advertising
- Use EMBEDDED LINKS to help visitors find more information
- Use bullets and numbered lists
  - supports skimming

[Landay 2002]

USING BULLETS



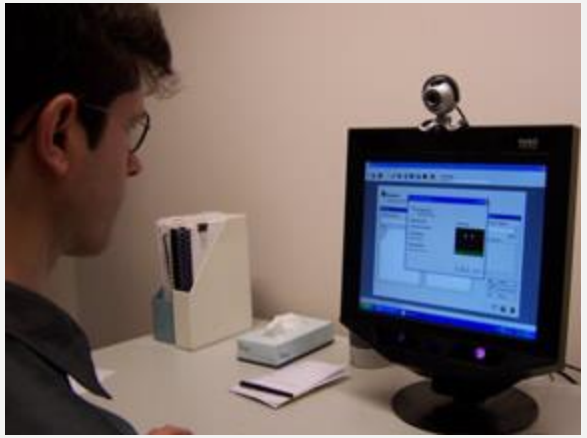
MEASURING THE USABILITY OF READING ON THE WEB

- Task time
  - seconds to find answers to specific content questions
- Errors
  - percentage of incorrect answers
- Memory
  - percentage of correct answers minus incorrect on post-test exam
- Time to recall site structure
  - number of seconds to draw a sitemap
- Subjective satisfaction
  - averaged 4 satisfaction-related questions

[Neilsen 2006]

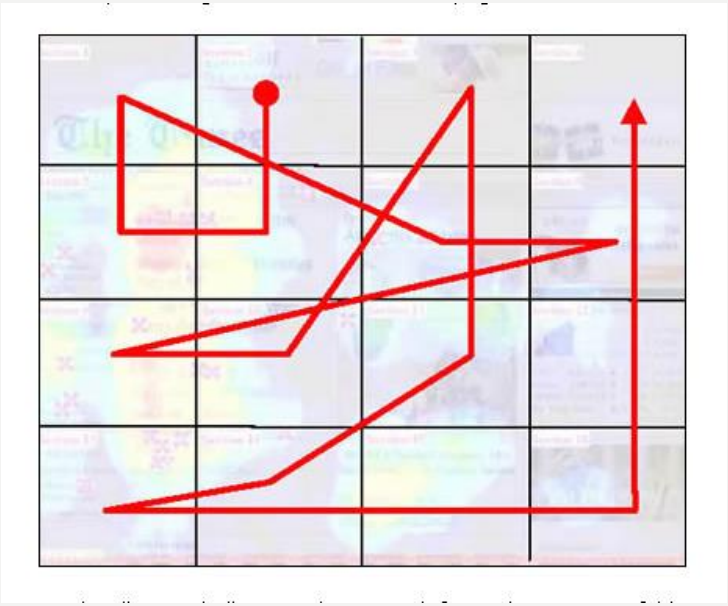
EYE-TRACKING STUDIES OF WEB PAGES

- Studied where and when users look at web pages
- Eye tracking equipment (video camera looks at shape of pupil)
- Hot spots - upper left
- Blind spots
- Poynter Institute: Eyetrack III, 2003



HOW THE EYES MOVE

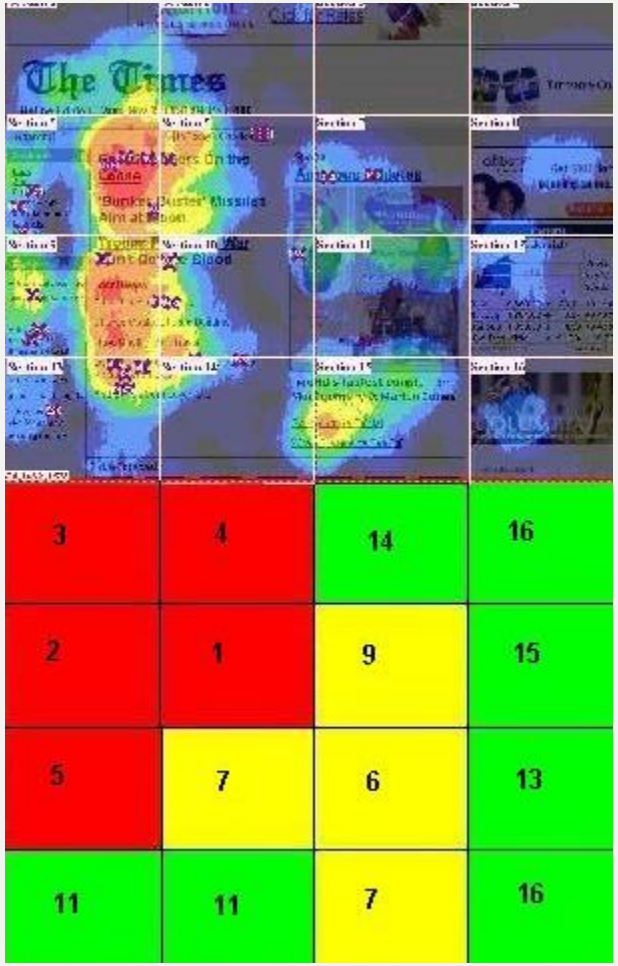
- Series of movements and pauses, called *saccades* (ave. 100 msec) and *fixations* (ave. 250 msec)
- Eyes follow a *scanpath*



[Eyetrack III, Poynter Inst. 2003]

HOW USERS LOOK AT NEWS WEB SITES

- Start in upper left quadrant
- Users look at text first
- Users look at the first few words of headlines
- Users read five headlines before clicking
- "Banner blindness" - users don't look at ads or quickly look away
  - Text ads viewed more than graphic ads



[Eyetrack III, Poynter Inst. 2003]

Heatmaps:

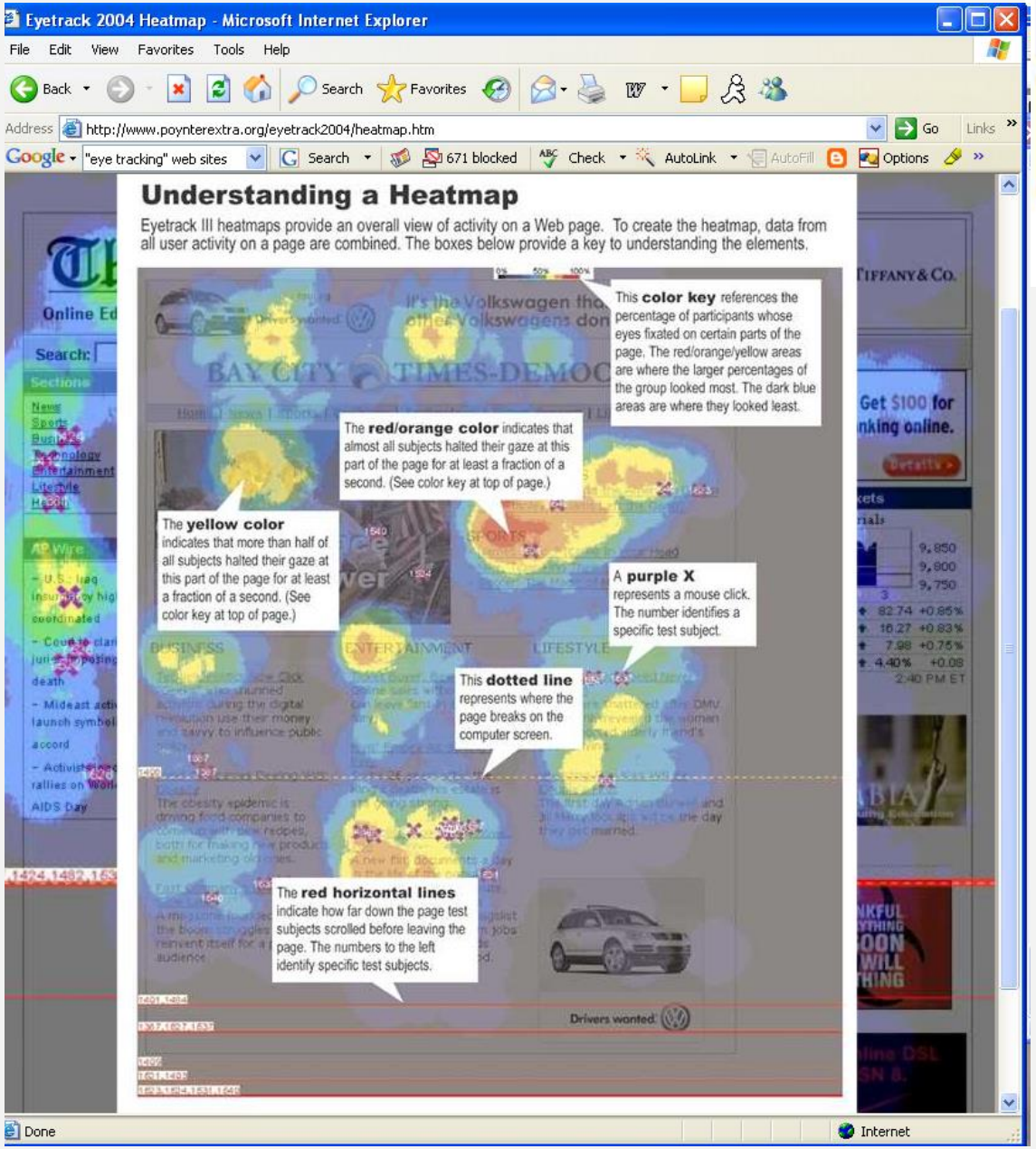
red: almost all

yellow: most

dotted line

purple X

red horizontal line




Marriott
HOTELS & RESORTS
Click for Rates
The Times
Online Edition · Mon Dec 1 11:39:17 PST 2003
TIFFANY & CO.
Search:
In Today's Chronicle
Sections
News
Sports
Business
Technology
Entertainment
Lifestyle
Health
AP Wire
- U.S.: Iraq insurgency highly coordinated
- Court to clarify on juries imposing death
- Mideast activists launch symbolic accord
- Activists plan rallies on World AIDS Day
Sex Offenders On the Loose
'Bunker Buster' Missiles Aim at Moon
Troops From Iraq War Can't Donate Blood
Local News
Antioch's Scrappy Boy
Shared Goals, Shared Building
Have Shuttle, Will Travel
Virtual Community
Sports
Amorous Athletes
MADRID
World's fastest couple: Tim Montgomery & Marion Jones
Roughing the Official
When Presidents Tee Off
citibank
Get $100 for banking online.
Markets
Dow Jones Industrials
9,850
9,800
9,750
DJIA 9,865.20 82.74 +0.85%
Nasdaq 1,978.53 16.27 +0.83%
S&P500 1,066.18 7.98 +0.75%
10yr Treas. Yield 4.40% +0.08
2:40 PM ET
COLUMBIA
7-day Forecast
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Advertisement
BE THANKFUL FOR EVERYTHING

RESPONSE TIMES: THE 3 IMPORTANT LIMITS

- **0.1 second** is the limit for having user feel system is reacting instantaneously
- **1.0 second** is the limit for user's flow of thought to stay uninterrupted (no feedback necessary, but user will lose feeling of operating directly on data)
- **10 seconds** is limit for keeping user's attention focused on page (for longer delays, percent-done progress indicator should be used)

[Nielsen 1997, Miller 1968, Card et al. 1991]

GRAPHIC DESIGN PRINCIPLES

- Proximity
- Alignment
- Consistency
- Contrast

PROXIMITY

- Items relating to each other should be grouped close together. They become one visual unit. Helps organize information and reduce clutter.

CD ROMs
Children's CDs
Educational CDs
Educational
Early learning
Language arts
Science
Math
Books
Teacher tools
Videos

CD ROMs
Children's CDs
Educational CDs

Educational
Early learning
Language arts
Science
Math

Teacher tools
Books
Teacher tools
Videos

ALIGNMENT

- Nothing should be placed on the page arbitrarily. Every item should have a visual connection with something else on the page.

CONSISTENCY

- Repeat some aspect of the design thoughout the entire site
  - can be a bold font, a thick rule, bullet, color, design element, format, spatial relationships, etc.

CONTRAST

- If two items are not exactly the same, then make them different. Really different.
  - Don't use two fonts that are slightly different -- that creates conflict
  - Can contract large type with small type, a graceful oldstyle font with bold sans serif font, a cool color with a warm color, a small graphic with a large graphic
- Don't contrast 12pt type with 14pt type or dark brown with black.

[Williams 1994]

COLOR SCHEMES

- Monochromatic
- Analogous
- Complementary
- Triadic

Monochromatic

This color scheme involves the use of only one hue. The hue can vary in value, and black or white may be added to create various shades or tints.

Analogous

This color scheme involves the use of colors that are located adjacent on the color wheel. The hues may vary in value. The color scheme for this site is analogous, with the colors varying only slightly from each other.

Complementary

This color scheme involves the use of colors that are located opposite on the color wheel such as red and green, yellow and purple, or orange and blue. Complementary colors produce a very exciting, dynamic pattern.

Triadic

This color scheme involves the use of colors that are equally spaced on the color wheel. The primary colors of yellow, red and green could be used together in a color scheme to produce a lively result.

[Skaalid 1999, Classic Graphic Design Theory]

TEXT AND BACKGROUND

- Maximize difference of intensity
- Don’t use patterned background
- Light on dark, dark on light?

TOP TEN WEB DESIGN MISTAKES

1. Legibility Problems
   - fixed font sizes
   - low contrast between text and background
2. Non-Standard Links
   - Make obvious what's clickable (use colored, underlined text)
   - Differentiate visited and unvisited links
   - Use keywords in anchor text (not "Click here")
   - Avoid JavaScript or other fancy techniques in links

[Nielsen Alertbox 2005]

TOP TEN WEB DESIGN MISTAKES

3. Flash
   - Flash should be used to offer users additional power and features that are not available from a static page
   - Most people equate animated content with useless content; a moving page doesn't increase users' attention, it drives them away
4. Content not written for the Web
   - Make it short, scannable, and to the point
5. Bad Search

[Nielsen Alertbox 2005]

TOP TEN WEB DESIGN MISTAKES

6. Browser Incompatibility
   - Many people use Firefox, Safari, and other minority browsers (don't just check your page in Internet Explorer)
7. Cumbersome Forms
   - Forms are used too often and are too big
   - Mandatory fields (State dropdown for int'l users)
   - Set keyboard focus to first field
   - Allow flexible input (phone and credit-card numbers)

[Nielsen Alertbox 2005]

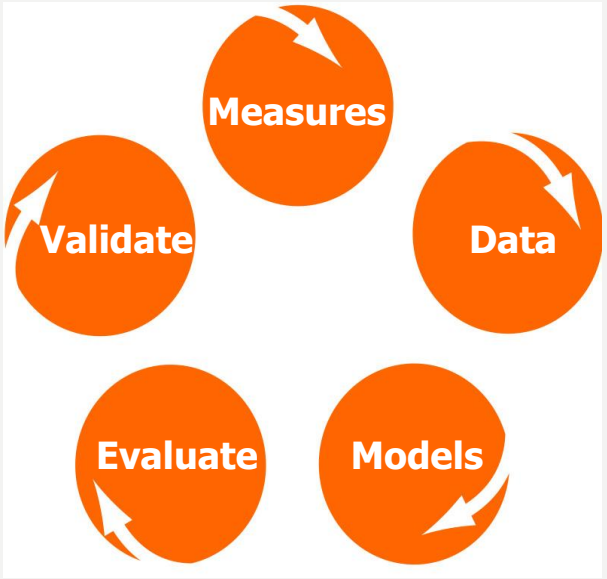
TOP TEN WEB DESIGN MISTAKES

8. No Contact Information
   - Credibility is important
9. Frozen Layouts with Fixed Page Widths
   - Users of large or small monitors have difficulties
   - Rightmost part of page is cut off when printing
10. Pop-Up Windows
   - Frozen viewports in pop-up windows
   - #1 on the list of most hated advertising techniques
   - Think about type of advertising you accept

[Nielsen Alertbox 2005]

DEVELOPING STATISTICAL PROFILES:
THE WEBTANGO APPROACH

Idea: Reverse engineer design patterns from high-quality sites and use to check the quality of other sites



- Create a large set of measures to assess various design attributes (benchmark)
- Obtain a large set of evaluated sites
- Create models of good vs. avg. vs. poor sites (guidelines)
  - Take into account the context and type of site
- Use models to evaluate other sites (guideline review)
- Validate models

[set of slides from Ivory, 2002]

1. **Considering mobile, tablet and PC users:**
   - a. How users can interact with the website, if they use small smart phone to browse the web?
   - b. How users can interact with the website if they use tablets?
   - c. How users can interact with the website if they use PC?
2. **Considering similar websites structures:**
   - a. Is the structure of the website similar to the other (close to the subject) websites?
   - b. Are the used icons and other metaphors similar to other websites?
   - c. All the similar icons and metaphors inside the website do the same thing?
3. **All Ajax link on the website should answer these three questions :**
   - a. What would be the user experience, if the link was clicked and URL was available?
   - b. What would be the user experience, if the link clicked and connection was disturbed?
   - c. What would be the user experience, if the link clicked and the URL was not available?
4. **All the actions that users might want to make must answer these questions:**
   - a. Is it clear in every page how to perform a desired action that might or might not be related to this page?
   - b. When an action was successfully performed, will an appropriate feedback be given to the users?
   - c. If an action failed, would an appropriate feedback be given to the users?
   - d. If the connection was lost while performing the action, would the state of the users be saved?
   - e. Are the effects of the action clear to the users?
   - f. Can users undo the actions they do not want in easy way and receive appropriate feedbacks?
5. **Considering Special users:**
   - a. Are blind color users able to use this website?
   - b. Are foreign users able to use this website?
   - c. Are people with disability able to use this website?

[Hajarian 2015]

MEASURING WEB DESIGN ASPECTS

- Identified key aspects from the literature
  - Extensive survey of Web design literature: texts from recognized experts; user studies
    - the amount of text on a page, text alignment, fonts, colors, consistency of page layout in the site, use of frames, …
  - Example guidelines
    - Use 2–4 words in text links [Nielsen00].
    - Use links with 7–12 useful words [Sawyer & Schroeder00].
    - Consistent layout of graphical interfaces result in a 10–25% speedup in performance [Mahajan & Shneiderman96].
    - Use several layouts (e.g., one for each page style) for variation within the site [Sano96].
    - Adhere to accessibility principles in order to create sites that serve a broad user community [Cooper99; Nielsen00]
    - Avoid using 'Click Here' for link text [Nielsen00]
    - Use left-justified, ragged-right margins for text [Schriver97]
  - No theories about what to measure

EMPIRICALLY VALIDATED WEB PAGE DESIGN METRICS IN WEBTANGO

- Quantitative measures: aspects impacting usability
- Identified 42 attributes from the literature
  - Page Composition
    - % body text, number of emphasized words, number of links, number of images, ...
  - Page Formatting
    - font count, number of lists, color count, …
  - Overall Page Characteristics
    - information & layout quality, download speed, …

PRACTICE 3

- End of Session 1

تمرین سوم – ۱ نمره

- طراحی مقدماتی یک سایت شخصی برای خودتان را بر اساس اصول طراحی که آموختید روی برگه یا به وسیله نرم افزار balsamiq mockups انجام دهید
- در طراحی خود اصول طراحی که آموختید را بکار گیرید

INSTRUCTIONS

- End of Session 1

برای هر تمرین مطابق فایل پرزنتیشن (دستور العمل) تکالیف خود را در قالب فایل **HTML** در بخش مربوط آپلود کنید تا ۰.۴۰ نمره برای هر تمرین از این طریق بدست می آید.
در جلسه حل تمرین آنها را در کلاس شرح دهید تا ۰.۱۰ نمره از این طریق بدست می آید.

- مهلت ارسال تا یک روز قبل از جلسه کلاس است
- ارسال با تاخیر و یا ارائه با تاخیر نمره ندارد
- تنها فایلهایی که از بخش مربوط در سایت ارسال شوند پذیرفته میشوند، از ایمیل کردن و ارسال با روش های دیگر مورد قبول نیستند.
- از قراردادن مسائلی که تدریس نشده در پاسخ ها خود داری کنید (نمره منفی خواهد داشت).

Q/A

- End of Session 5

THANK YOU!