SE2250 – Software Construction

Lecture #10

Graphical User Interfaces and Software Evolution

April 1, 2019

Outline

- Graphical User Interfaces (GUI)
    - GUI – desired attributes
    - Event-driven programming
- Software Evolution

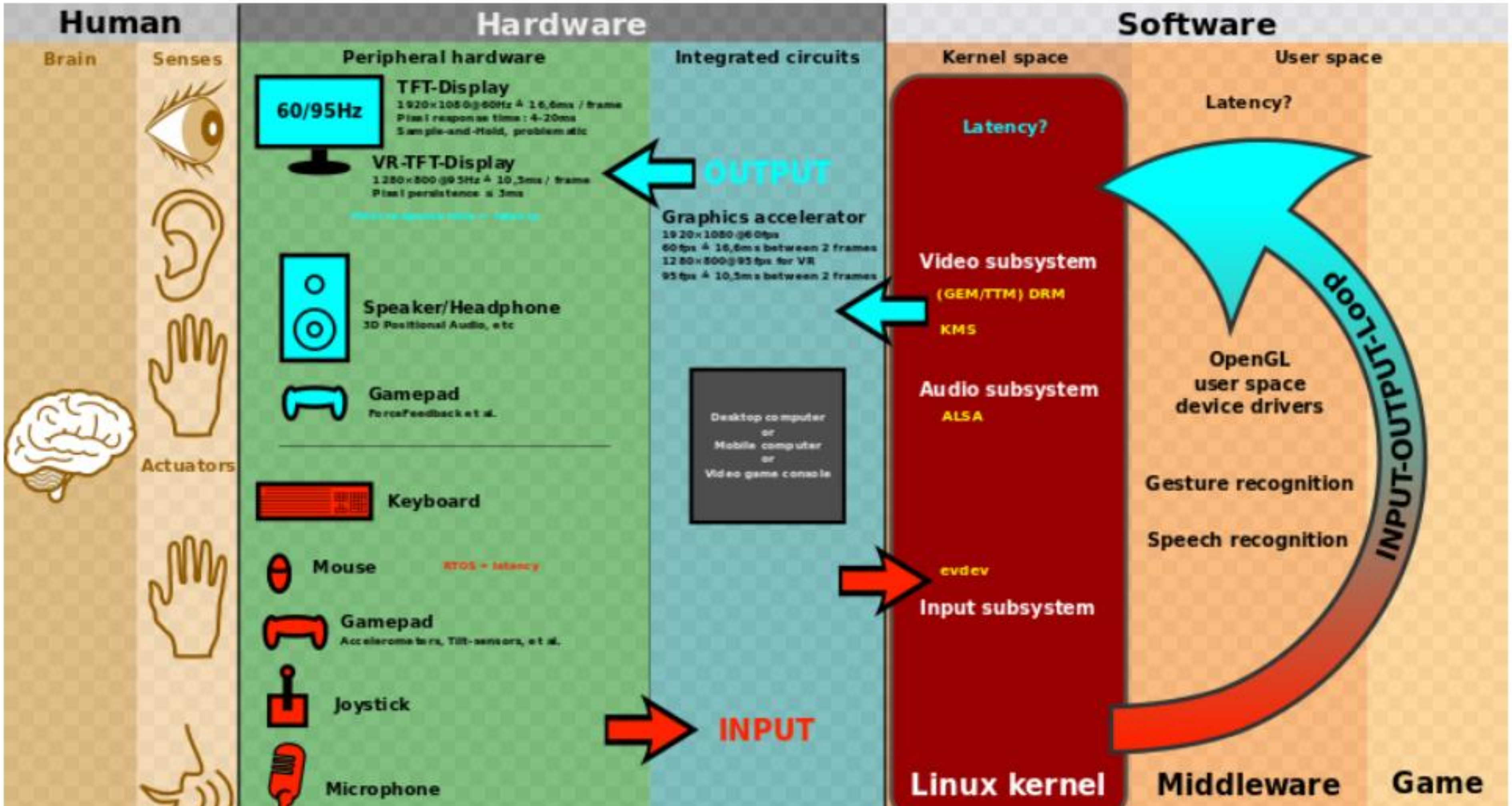
Graphical User Interfaces

- **User interface** – the space where humans interact with machines

- **Text-based user interfaces** – primarily interaction through text (examples?)
- **Graphical user interfaces (GUI)** – interaction happens through graphical elements

GUI

- GUI – how it works



GUI

- Users motivation to learn
- Software designed for intermediate-to-expert users:
  - Code development environments
  - System-administration tools for web servers
  - Excel (for a beginner too?)
- Software designed for occasional users:
  - Purchase pages for online stores
  - Automated teller machines
  - Kiosks in tourist centers or museums

GUI

- Desired attributes
  - **Safe Exploration**

    “Let me explore without getting lost or getting into trouble.”
  - **Satisficing**

    “This is good enough. I don’t want to spend more time learning to do it better.”
  - **Changes in Midstream**

    “I changed my mind about what I was doing.”

GUI

- Desired attributes…
  - **Deferred Choices**

    “I don’t want to answer that now; just let me finish!”
  - **Incremental Construction**

    “Let me change this. That doesn’t look right; let me change it again. That’s better.”
  - **Habituation**

    “That gesture works everywhere else; why doesn’t it work here, too?”
  - **Microbreaks**

    “I’m waiting for the train. Let me do something useful for two minutes.”

GUI

- Desired attributes…
  - **Spatial Memory**

    “I swear that button was here a minute ago. Where did it go?”
  - **Streamlined Repetition**

    “I have to repeat this how many times?”
  - **Keyboard Only**

    “Please don’t make me use the mouse.”

…

GUI

- **Designing interfaces**
- Varies among applications and among platforms

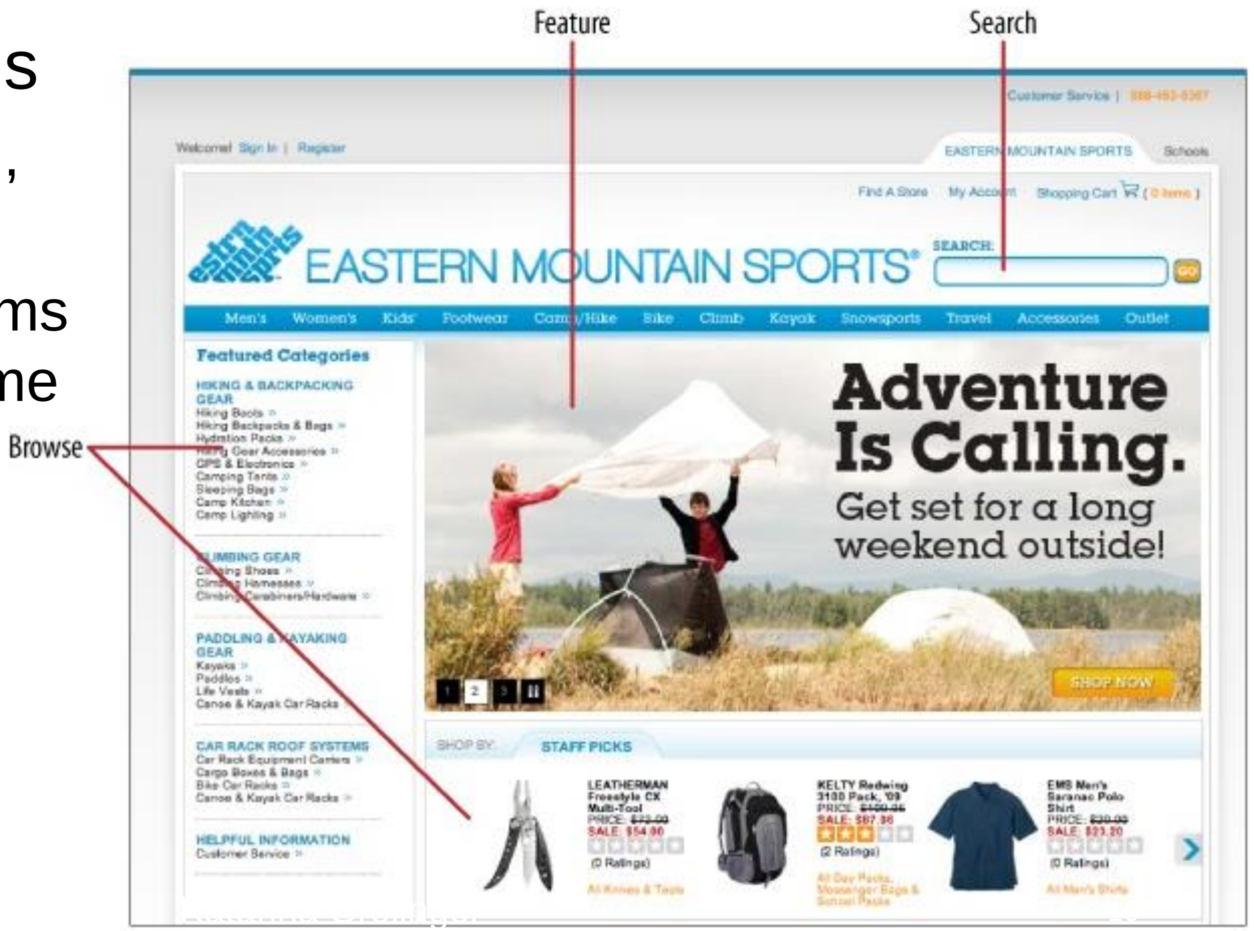
- Things to consider:
  1. Organizing the content
  2. Getting around/navigation
  3. Organizing the page/layout
  4. Doing things (actions and commands)
  5. Getting input from users

  …

GUI

1. Organizing the content

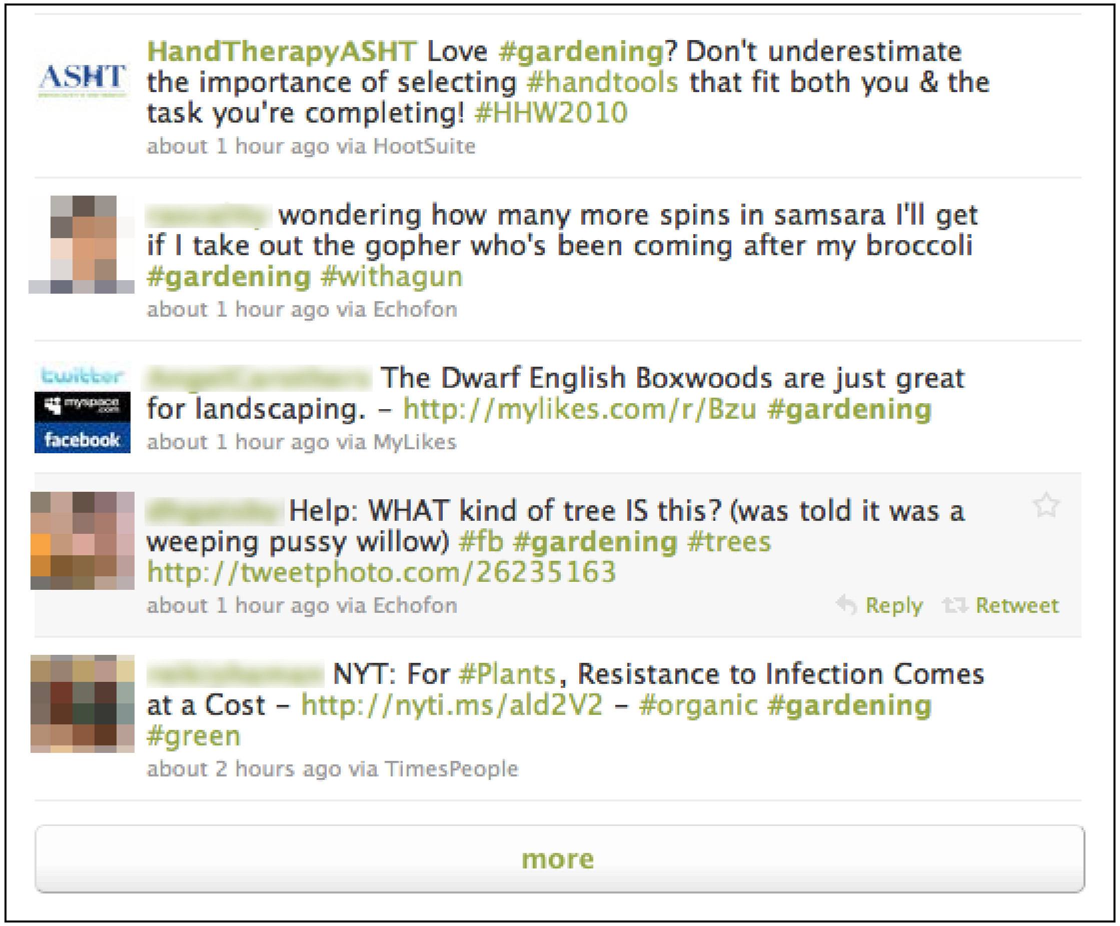
- Example patterns
  - Feature, Search, and Browse
  - When: many items but highlight some


Feature
Search
Browse
EASTERN MOUNTAIN SPORTS
SEARCH:
Men's Women's Kids Footwear Camp/Hike Bike Climb Kayak Snowsports Travel Accessories Outlet
Featured Categories
Adventure Is Calling.
Get set for a long weekend outside!
SHOP NOW
STAFF PICKS

GUI

1. Organizing the content

- Example patterns
  - News stream
  - When: timely content



HandTherapyASHT Love #gardening? Don't underestimate the importance of selecting #handtools that fit both you & the task you're completing! #HHW2010
about 1 hour ago via HootSuite

[redacted] wondering how many more spins in samsara I'll get if I take out the gopher who's been coming after my broccoli #gardening #withagun
about 1 hour ago via Echofon

[redacted] The Dwarf English Boxwoods are just great for landscaping. – http://mylikes.com/r/Bzu #gardening
about 1 hour ago via MyLikes

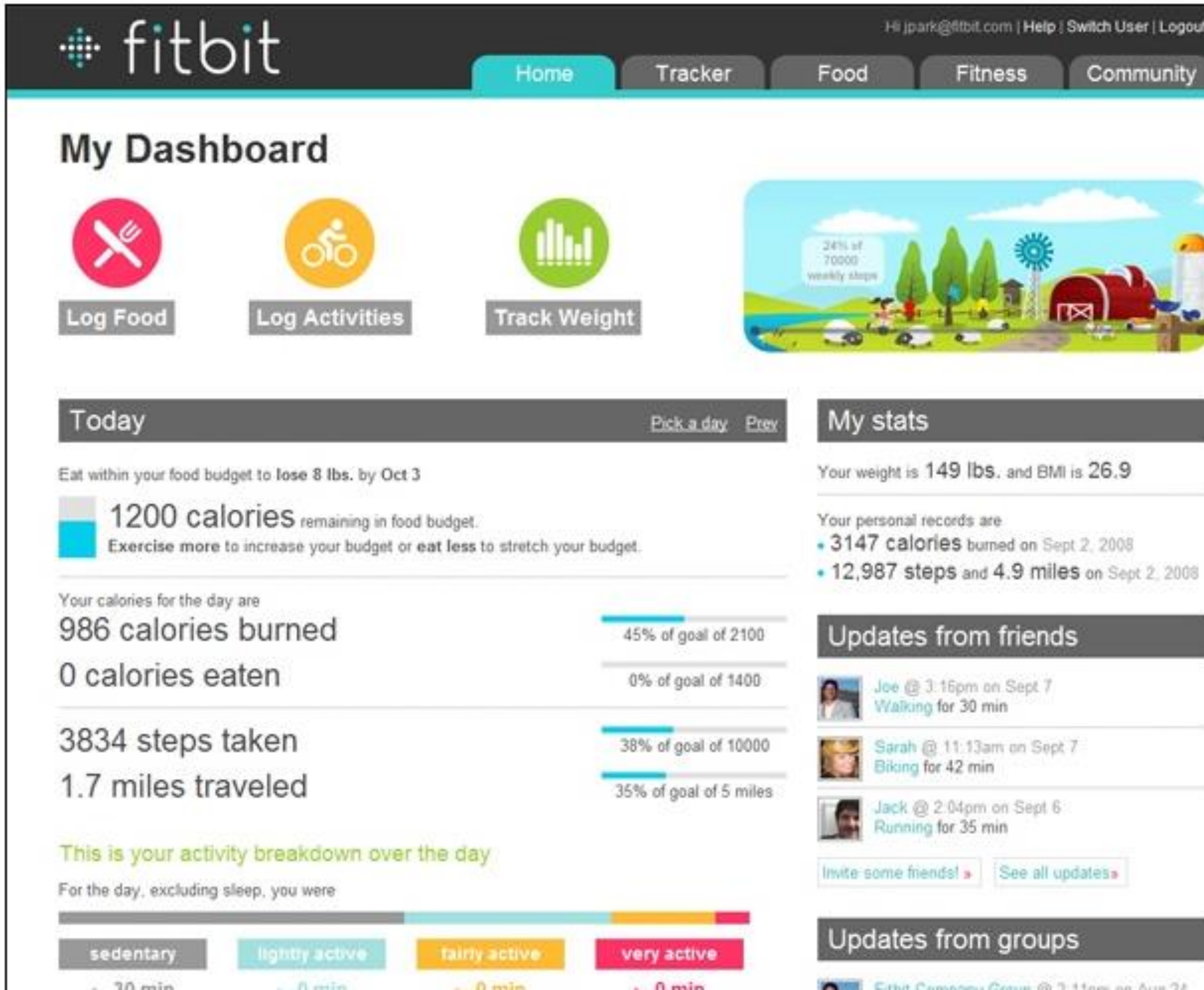
[redacted] Help: WHAT kind of tree IS this? (was told it was a weeping pussy willow) #fb #gardening #trees http://tweetphoto.com/26235163
about 1 hour ago via Echofon

[redacted] NYT: For #Plants, Resistance to Infection Comes at a Cost – http://nyti.ms/ald2V2 – #organic #gardening #green
about 2 hours ago via TimesPeople

GUI

1. Organizing the content

- Example patterns
  - Dashboard
  - When: timely content



Hi jpark@fitbit.com | Help | Switch User | Logou

Home | Tracker | Food | Fitness | Community

My Dashboard

Log Food | Log Activities | Track Weight

Today — Pick a day Prev

Eat within your food budget to lose 8 lbs. by Oct 3

1200 calories remaining in food budget.
Exercise more to increase your budget or eat less to stretch your budget.

Your calories for the day are

986 calories burned	45% of goal of 2100
0 calories eaten	0% of goal of 1400
3834 steps taken	38% of goal of 10000
1.7 miles traveled	35% of goal of 5 miles

This is your activity breakdown over the day

For the day, excluding sleep, you were

sedentary | lightly active | fairly active | very active

My stats

Your weight is 149 lbs. and BMI is 26.9

Your personal records are
- 3147 calories burned on Sept 2, 2008
- 12,987 steps and 4.9 miles on Sept 2, 2008

Updates from friends

Joe @ 3:16pm on Sept 7
Walking for 30 min

Sarah @ 11:13am on Sept 7
Biking for 42 min

Jack @ 2:04pm on Sept 6
Running for 35 min

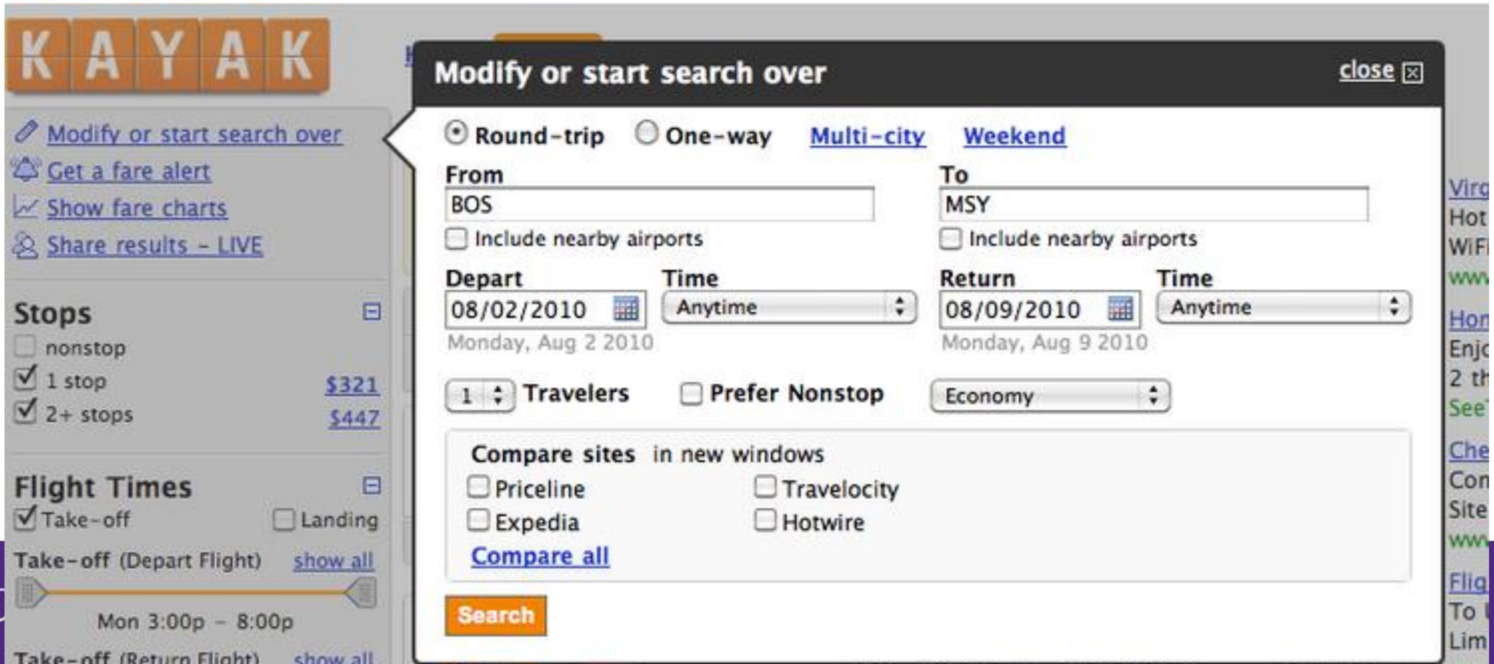
Invite some friends! » | See all updates»

Updates from groups

GUI

2. Getting around/navigation

- Example
  - Modal panel
  - Show only one page, with no other navigation options, until the user finishes the immediate task



KAYAK

Modify or start search over
Get a fare alert
Show fare charts
Share results - LIVE

Stops
☐ nonstop
☑ 1 stop $321
☑ 2+ stops $447

Flight Times
☑ Take-off ☐ Landing
Take-off (Depart Flight) show all
Mon 3:00p - 8:00p
Take-off (Return Flight) show all

Modify or start search over close ☒

[✓ Round-trip] One-way Multi-city Weekend

From	To
BOS	MSY
☐ Include nearby airports	☐ Include nearby airports

Depart	Time	Return	Time
08/02/2010	Anytime	08/09/2010	Anytime
Monday, Aug 2 2010		Monday, Aug 9 2010	

1 Travelers ☐ Prefer Nonstop Economy

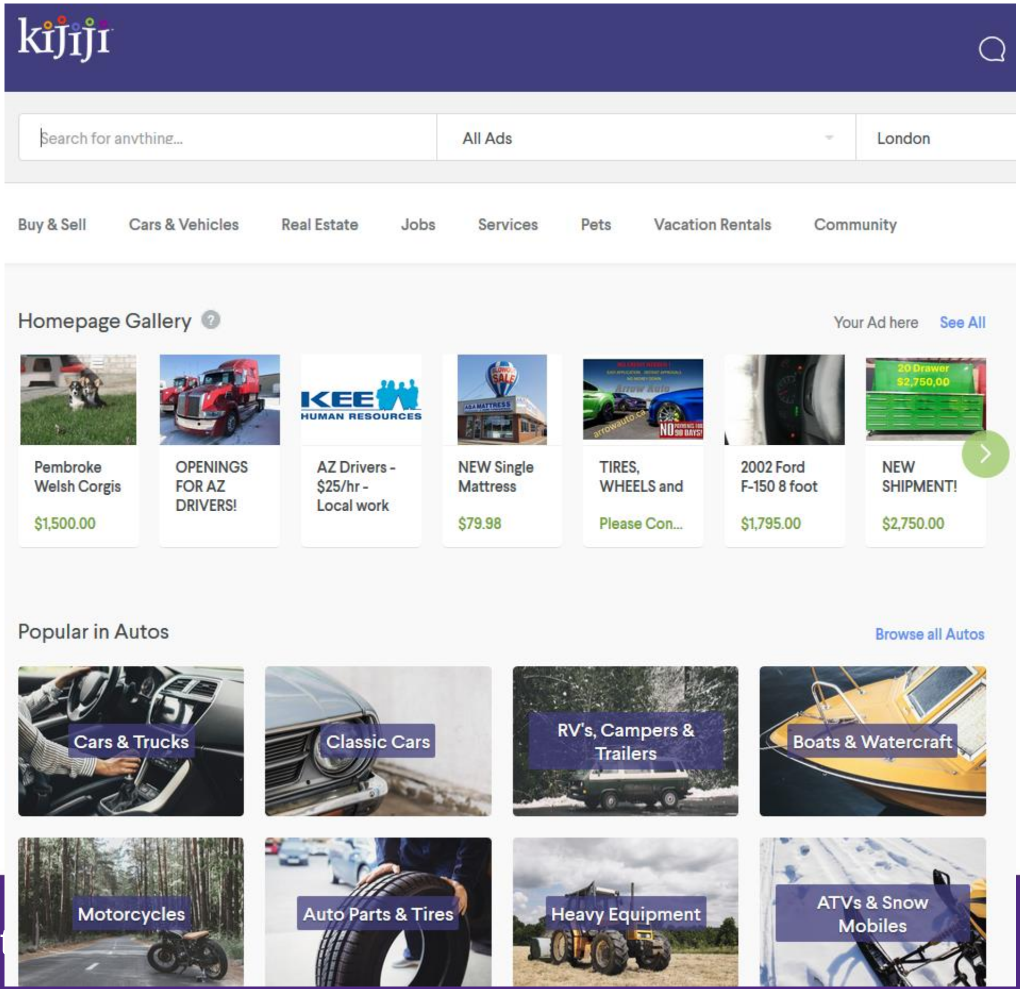
Compare sites in new windows
☐ Priceline ☐ Travelocity
☐ Expedia ☐ Hotwire
Compare all

Search

GUI

2. Getting around/navigation

- Example
  - Menu page

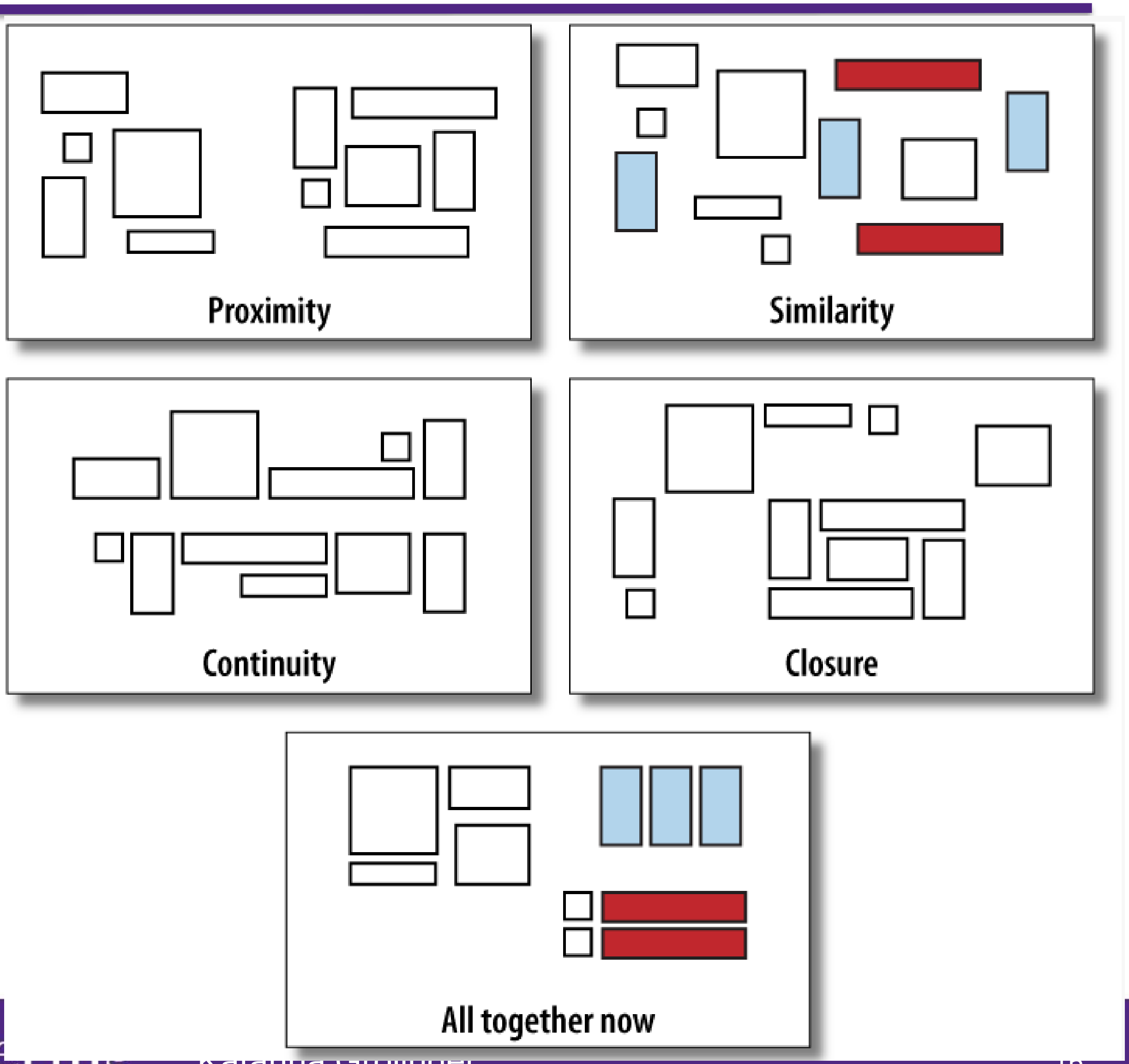


GUI

3. Organizing the page/layout
   - **Proximity**
     - Put things close together, and viewers will associate them with one another.
   - **Similarity**
     - If two things are the same shape, size, color, or orientation, viewers will also associate them with each other.
   - **Continuity**
     - Our eyes want to see continuous lines and curves formed by the alignment of smaller elements.
   - **Closure**
     - We want to see simple closed forms, such as rectangles and blobs of whitespace, that aren’t explicitly drawn for us. (appear to be closed forms).

GUI

3. Organizing the page/layout



GUI

4. Doing things (actions and commands)
   - Buttons
   - Menu bars
   - Pop-up menus
   - Drop-down menus
   - Toolbars
   - Hover tools
   - Double-clicking
   - Keyboard actions
   - Drag-and drop
   - …

GUI

5. Getting input from users
   - Somewhat similar to 'doing things'
   - Text fields: single, multiline, with formatting…
   - Numbers: forgiving format, structured format, spin box, sliders, …

   - A few patterns:
     - Autocompletion
     - Password strength meter
     - Good defaults

GUI

- These guidelines, patterns, and tips help us design user interfaces
- But, how do we implement/code these interactions?
- Event-driven programming

Event-driven programming

- **Event-driven programming** is a programming paradigm in which the flow of the program is determined by events such as user actions (mouse clicks, key presses), sensor outputs, or messages from other programs/threads
- Dominant in graphical user interfaces

- **Event Loop**
  - Typically, program will wait for the user to activate one of its widgets
  - Then it does something in response
  - Goes back to waiting

Event-driven programming

- An event occurs whenever an **event listener** detects an **event trigger** and responds by running a method called an **event handler**.
- An **event trigger** can be almost any activity or condition selected by the programmer, such as a mouse movement, someone pressing the enter key, or a bank account balance changing.
- An **event handler** is a method that is activated when the event trigger occurs.

Event-driven programming

- Event driven programming in Unity?
- Unity examples?
  - OnMouseDown()
  - Update()
  - Start()
  - …
- Where can we find these events?

Event-driven programming

- Display scores, buttons to stop/restart, tips…?
  - Camera may be moving to show different parts of the scene
  - Score should always show on the same place
- Unity User Interfaces (UI)
  - For user interaction, but different from objects making "Game World"
  - Not necessary moving when the camera position changes
  - All UI elements are inside the canvas
  - Creating a new UI element, such as an Image using the menu GameObject > UI > Image, automatically creates a Canvas

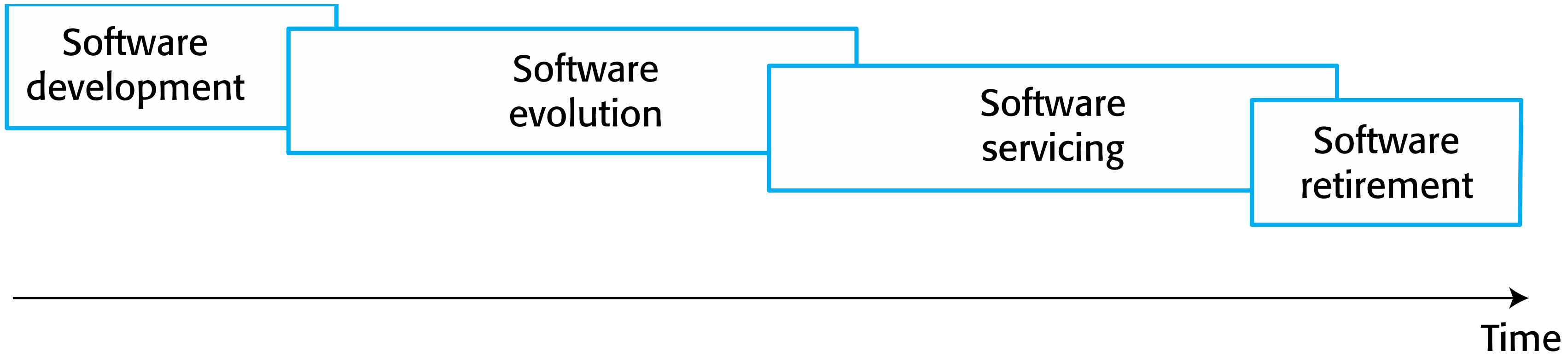
Software Evolution

Software Evolution

- Software change is inevitable
  - New requirements emerge when the software is used.
  - The business environment changes.
  - Errors must be repaired.
  - New computers and equipment is added to the system.
  - The performance or reliability of the system may have to be improved.
- **Software Maintenance** term is mostly used for changing custom software. Generic software products are said to **evolve** to create new versions.

Software Evolution

- Evolution and servicing



Software Evolution

- Evolution
  - The stage in a software system’s life cycle where it is in operational use and is evolving as new requirements are proposed and implemented in the system.
- Servicing
  - At this stage, the software remains useful but the only changes made are those required to keep it operational i.e. bug fixes and changes to reflect changes in the software’s environment. No new functionality is added.
- Phase-out
  - The software may still be used but no further changes are made to it.

Software Evolution

- Legacy Systems
  - Legacy systems are older systems that rely on languages and technology that are no longer used for new systems development.
  - Legacy software may be dependent on older hardware, such as mainframe computers and may have associated legacy processes and procedures.
  - Legacy system replacement is risky and expensive so businesses continue to use these systems

Software Evolution

- Key points
  - For custom systems, the costs of software maintenance usually exceed the software development costs.
  - The majority of the software budget in large companies is devoted to changing and evolving existing software rather than developing new software.
  - It is often cheaper and less risky to maintain a legacy system than to develop a replacement system using modern technology.