Java AWT

20TH WEEK LECTURE

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Outline

- **AWT Basic**
- **Use AWT**
- **AWT Event**
- **Specific things**

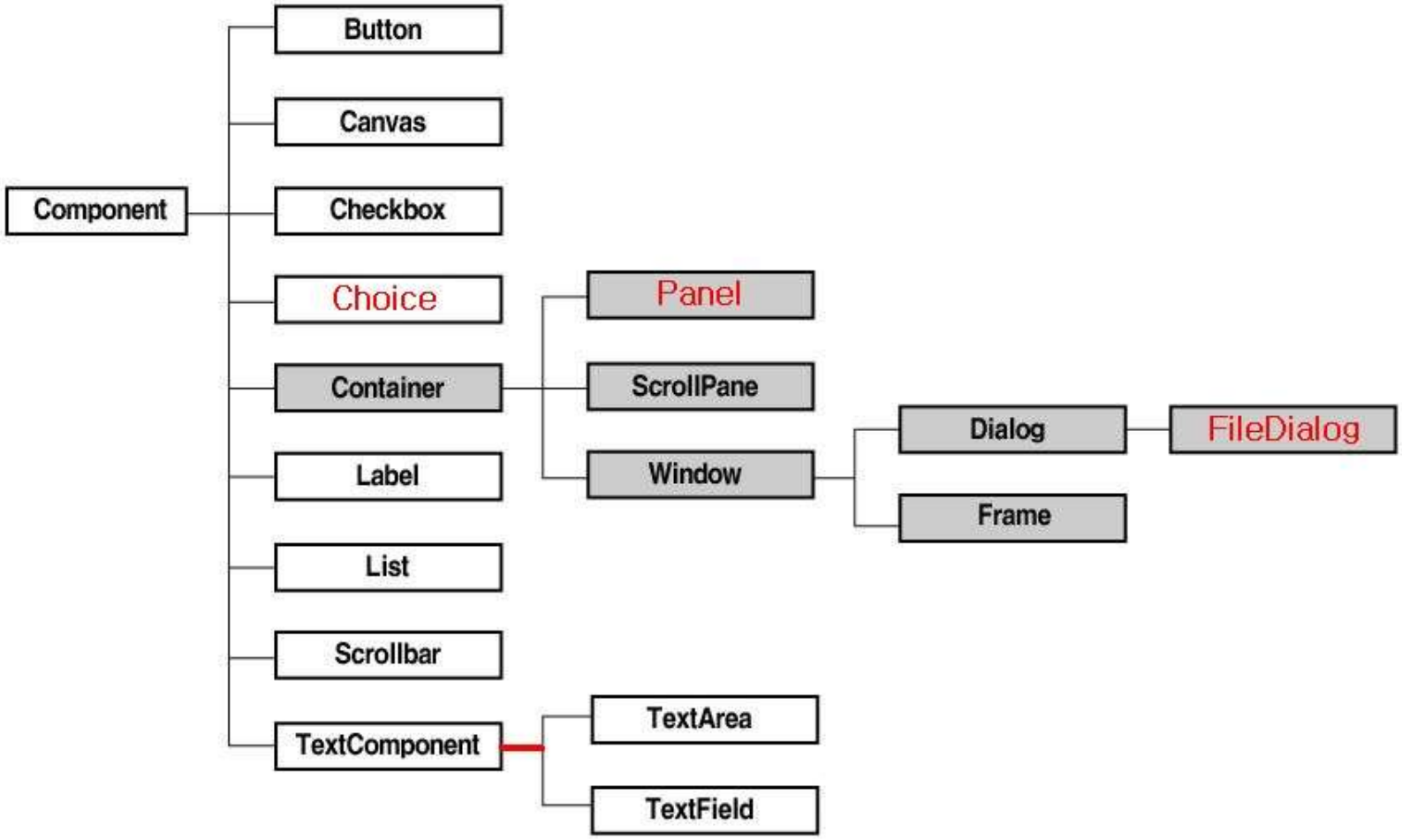
What is the AWT?

- Classes which have a collection of common graphic functions supporting several GUI platforms
  - A classical method of windows programming
  - Based on system executing GUI graphic
  - Heavyweight component → •So use Swing •Swing is light component
  - java.awt.* Have to import this
- Function
  - Control and manage graphic contexts
  - Draw shapes and text
  - Control and manage images

Why we have to know AWT?

- Two kinds of user interface
  - CUI (Character User Interface)
  - GUI (Graphical User Interface)
- Many programs are based on GUI
  - Windows, Media Player, Editplus, games etc.
- In java, you can programming GUI using AWT and Swing

AWT Components



How to use components

1. Generate a component

   Button myButton = new Button (“my button”);

2. Add component on container

   add(myButton);

3. Connect event listener and event control routine

   MyActionListener mal = new MyActionListener();

   myButton.addActionListener(mal);

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Event

- Event
  - Response about user's behavior about UI components
- Programming based on event
  - Using busy waiting, watch user's behavior and response about that

Event Handling

- java.awt.event
  - Provide interfaces and class for handle several events from AWT component
  - xxxListener, xxxEvent, xxxAdapter
    - xxxListener: interface
    - xxxEvent, xxxAdapter: class
- Delegated event handling model
  - Register object (event listener) at Component (event source) for event handling

Kinds of event

- Low-level event and semantic event

Low-level event
System level events resulted from user's input or component's function

Semantic event
Using low-level event, make a second event
(e.g) mouse click → pressed, released 2 kinds of low-level event occur
=> Handled by ActionEvent

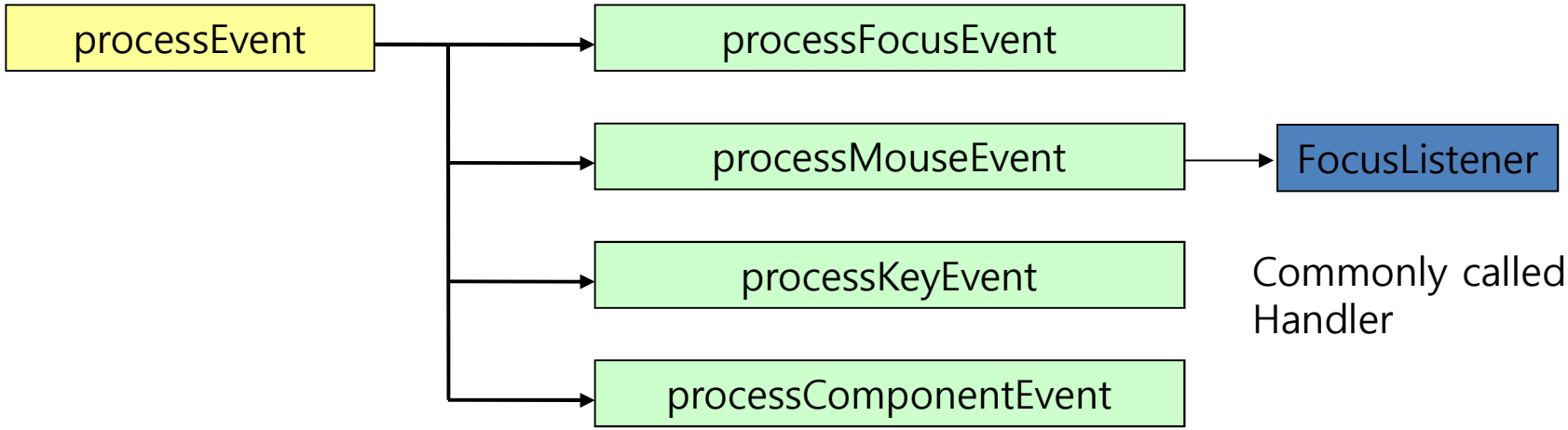
Kinds of low-level event
java.awt.event.ComponentEvent
java.awt.event.FocusEvent
java.awt.event.KeyEvent
java.awt.event.MouseEvent
java.awt.event.WindowEvent

Kinds of semantic event
java.awt.event.ActionEvent
java.awt.event.AdjustmentEvent
java.awt.event.ItemEvent
java.awt.event.TextEvent

In practical event handling, these are not distinguished handling semantic event is more efficient

Step for calling event listener

- processEvent
  - When event occur at component, call event listener



e.g) FocusEvent

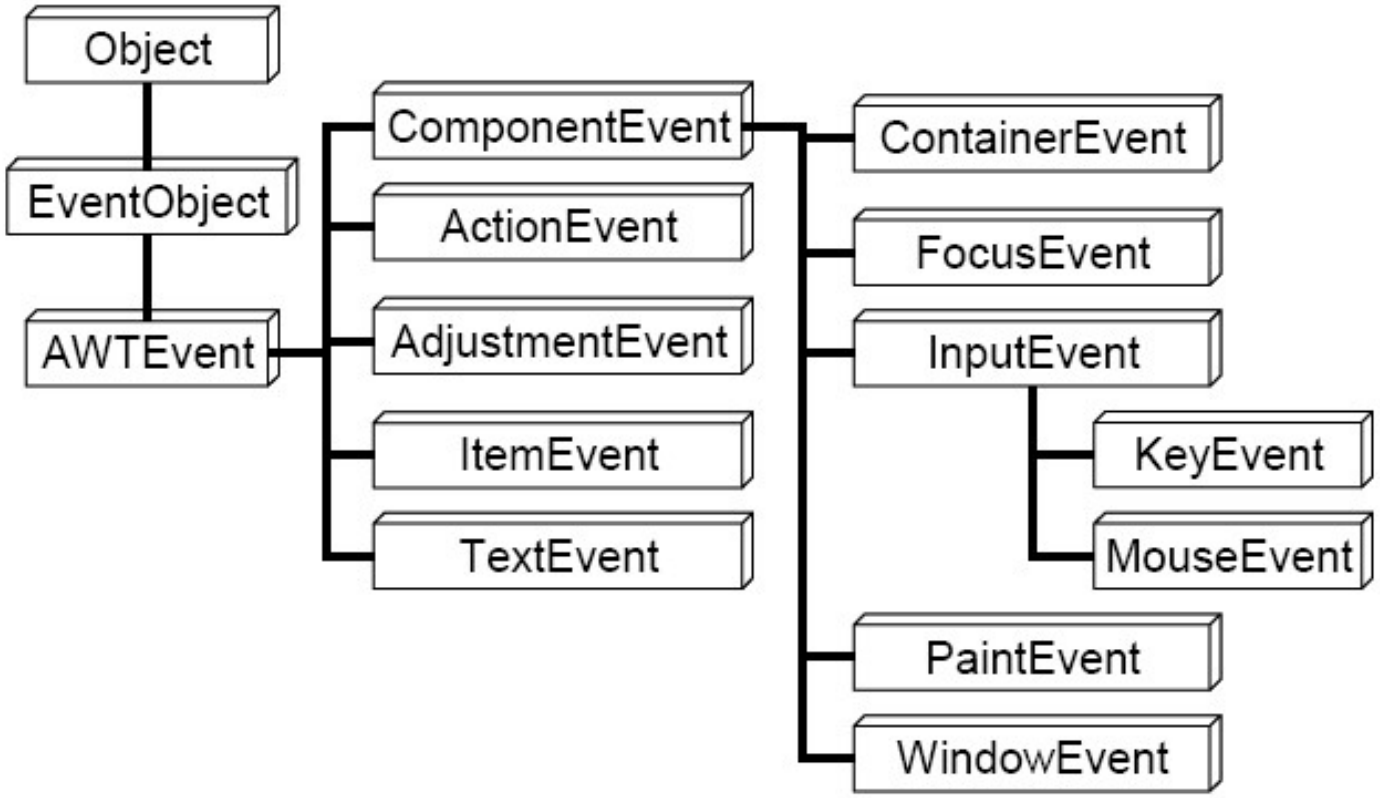
processEvent => processFocusEvent => FocusListener, and process it based on ID

Event class and Event listener

- Classify kinds of event that can be occur at component
  - Event classes have information and method about event

- Fixed event at each components
  - Button event
    - ActionEvent, ComponentEvent, FocusEvent, KeyEvent, MouseEvent
  - Components that ActionEvent can be occur
    - Button, List, MenuItem, TextField
  - Etc. referencing API

Hierarchy of event classes



Event class and Event listener

- Listener is interface handling events
  - xxxEvent class maps onto xxxListener
- xxxListener have method handling low-level event
  - E.g) KeyListener handling KeyEvent
    - void keyPressed(KeyEvent e)
    - void keyReleased(KeyEvent e)
    - void keyTyped(KeyEvent e)

Event handling process

- Decide the event to handle
  - E.g) ActionEvent
- Define a class which include event listener
  - E.g) MyListener is a class Implementing ActionListenerClass
    MyListener implements ActionListner{ …}
    - Implement void actionPerformed(ActionEvent e)
  - Each listener has different implement (referencing API)
- Generate an object and register it as event listener
  - this.addActionListener(new MyListener());

Event adapter

- Easy to handling low-level event
  - Listener interface which has event handling methods over 2(xxxListener)and Adapter class which implement those things.
  - Each event handling method is empty block
- If there is adapter, define inherited class instead of implementing listener

```
import java.awt.*;
import java.awt.event.*;
//어댑터를 상속
class MyListner extends WindowAdapter {
  public void windowClosing(WindowEvent ev) {
   System.exit(0);
  }
}
```

Overriding

ActionEvent and ActionListener

- Major methods of ActionListener
  - void actionPerformed(ActionEvent ev)
  - Example of event occurrence
    - Click a button
    - Click a menu
    - Press enter key at TextField
    - Double click a element of list
- Major methods of ActionEvent
  - String getActionCommand()
    - Return a command name
  - Object getSource()
    - Inherited method at EventObject

```
class MyListener implements ActionListener {
    public void actionPerformed(ActionEvent ev) {
        System.out.println(((Button)ev.getSource()).getLabel());
        System.out.println(ev.getActionCommand());
        if ("OK".equals(ev.getActionCommand())) {
            System.out.println("OK 버튼이 눌렸습니다.");
        } else if ("Cancel".equals(ev.getActionCommand())) {
            System.out.println("Cancel 버튼이 눌렸습니다.");
        }
    }
}
```

WindowEvent and WindowListener

- Major methods of WindowListener
  - Case changing the state of windows
  - void windowActivated(WindowEvent ev)
  - void windowClosed(WindowEvent ev)

- Major methods of WindowEvent
  - int getNewState()
    - 0 is common state
  - int getOldState()
  - Window getWindow()

ItemEvent and ItemListener

- Major methods of ItemListener
  - void itemStateChanged(ItemEvent ev)
  - Select Item or release item at Checkbox, CheckboxMenuItem, Choice, List

- Major methods of ItemEvent
  - Object getItem()
  - int getStateChange()
  - String paramString()

AdjustmentEvent and AdjustmentListener

- Major methods of AdjustmentListenervoid adjustmentValueChanged(AdjustmentEvent ev)
  - Case changing the state of scroll bar

- Major methods of AdjustmentEvent
  - int getValue()
  - int getAdjustmentType()
    - UNIT_INCREMENT, UNIT_DECREMENT,
  - BLOCK_INCREMENT,BLOCK_DECREMENT, TRACK

KeyEvent and KeyListener

- When event related with Keystrock occurs, KeyEvent occurs
- Major methods of KeyListener
  - keyPressed(KeyEvent ev)
  - keyReleased(KeyEvent ev)
  - keyTyped(KeyEvent ev)
- Major methods of KeyEvent
  - char getKeyChar()
  - int getKeyCode()
  - int getKeyLocation()
  - static String getKeyText(int keyCode)
  - static String getKeyModifiersText(int)

MouseEvent and listener

- When event related with a mouse occurs, MouseEvent occurs
- Major methods of MouseListener
  - mouseClicked(MouseEvent ev)
  - mousePressed(MouseEvent ev)
  - mouseReleased(MouseEvent ev)
- Major methods of MouseMotionListener
  - mouseDragged(MouseEvent ev)
  - mouseMoved(MouseEvent ev)
- Major methods of MouseEvent
  - int getButton()
  - Point getPoint()

TextEvent and FocusEvent

- Major methods of TextListenertextValueChanged(TextEvent ev)
  - When texts are changed at TextArea and TextFiled, event occurs and listener executes
- Major methods of FocusListener
  - When component gets or misses input focus, event
- occurs and listener executes
  - focusGained(FocusEvent ev)
  - focusLost(FocusEvent ev)

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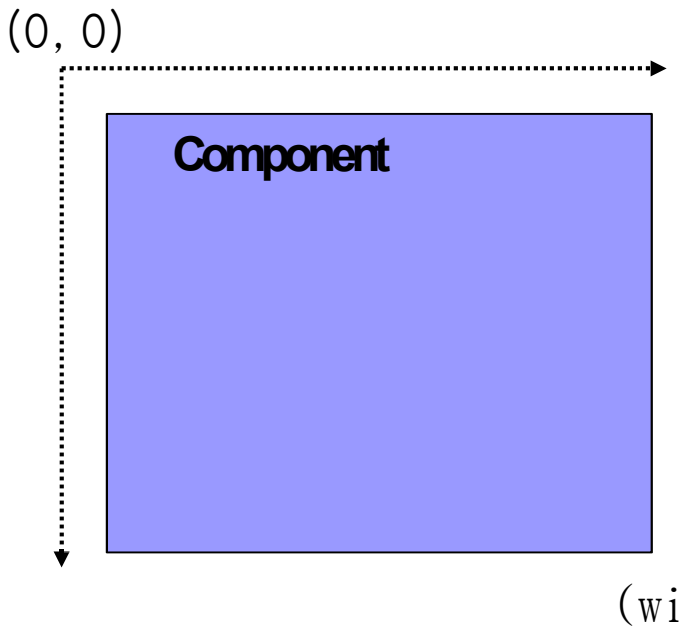
Graphic Context

- Environments for Graphic tasks
  - EX) coordinates, background color, foreground color, font
- Major characteristic managed by graphic context
  - Object to be drawn : target object that graphic object
- will draw
  - Coordinate system : coordinate information for drawing base
  - Current clipping area : clipping information
    - Clipping area save information of area to be redrawn
  - Current color and font : information of color and font for drawing

Coordinate System

- General coordinate system in computer graphic
  - Left top is (0, 0)
  - X-axis increases to right side
  - Y-axis increases to down side

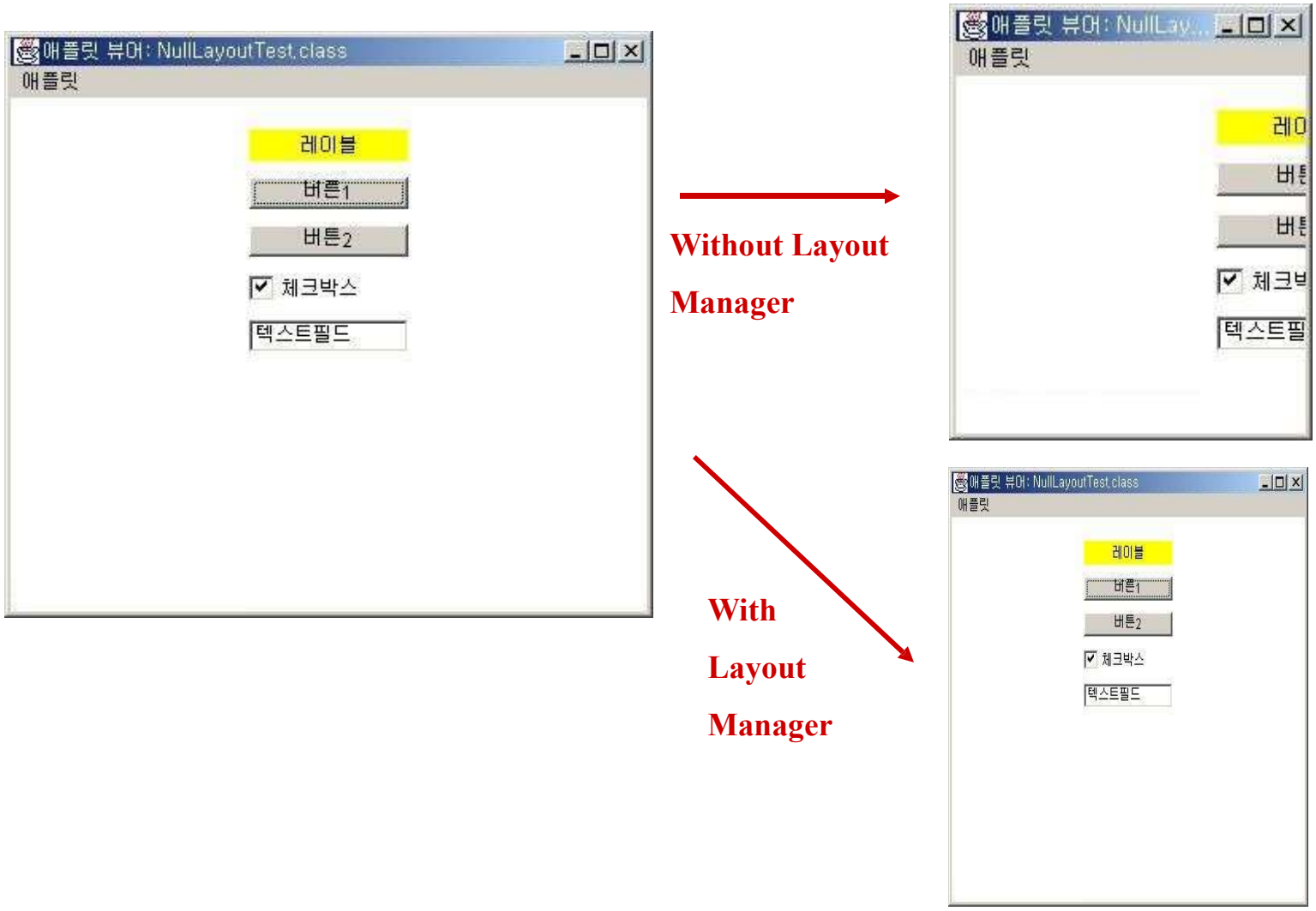


Ex)
Case of Rectangle width * height

Layout Manager

- Manage Position
  - Manage component position attached to container
- Type of Layout
  - BorderLayout
  - BoxLayout
  - CardLayout
  - FlowLayout
  - GridBagLayout
  - GridLayout
  - SprintLayout

Role of Layout Manager



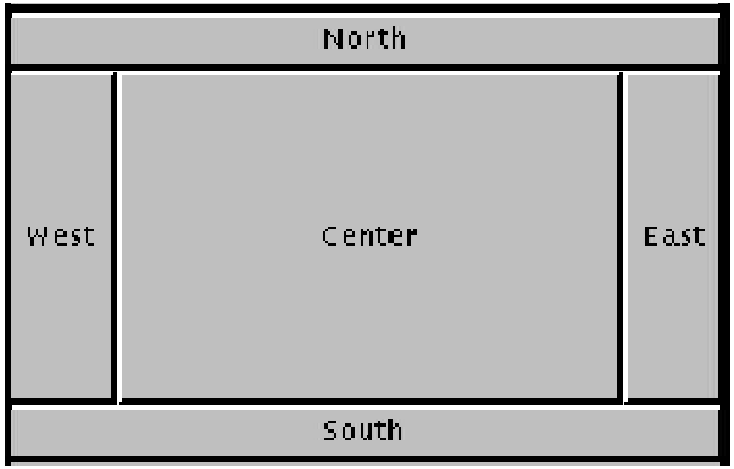
Hot to Set Layout

1. Create layout manager
   - BorderLayout bm = new BorderLayout();
2. Set layout manager of component
   - setLayout(bm);
3. Add component
   - add(myButton); →

•Arguments varies with layout manager
•See layout class in API for more information

BorderLayout

- Organize layout like the picture on the left
- Site image on the specific position with argument adding component




```
public LayoutFrame(){  setLayout(new BorderLayout());
add(new Button("North"), BorderLayout.NORTH);  add(new
        Button("South"), BorderLayout.SOUTH);  add(new
        Button("East"), BorderLayout.EAST);  add(new
        Button("West"), BorderLayout.WEST);  add(new
        Button("Center"), BorderLayout.CENTER);

}
```

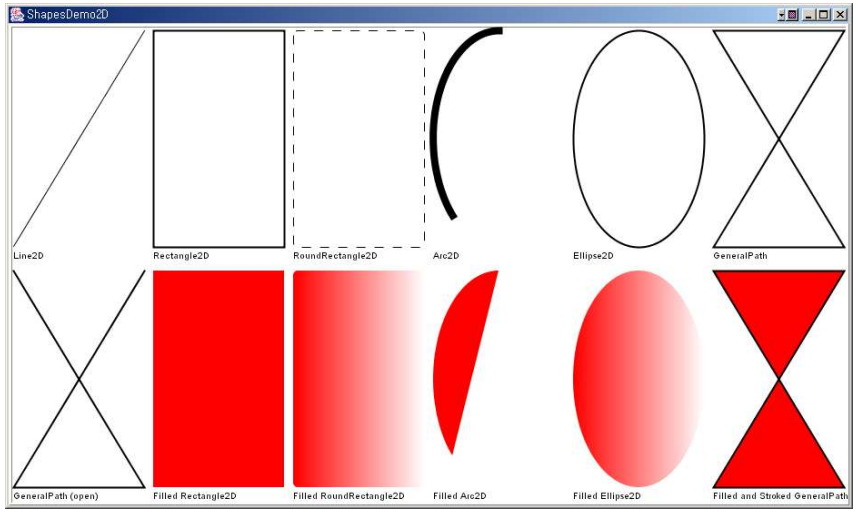
Color and Font

- Color
  - Use for setting graphic object color. R, G, B and Alpha
  - Major constructor
    - Color(float r, float g, float b, float a)
    - Color(int r, int g, int b, int a)
- Font
  - Font type and size used for printing text on the screen
    - BOLD, ITALIC, PLAIN
  - Major method
    - getFont(), setFont(Font font)…
    - See API for more information`

Draw Shape

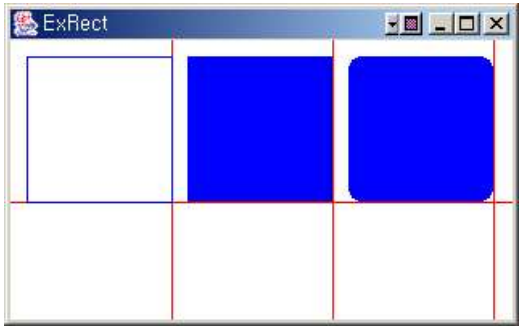
- Fill in Shape : start with fill. Ex) fillArc, fillRect…
- Draw shape outline : start with draw. Ex)
- drawArc, drawRect…

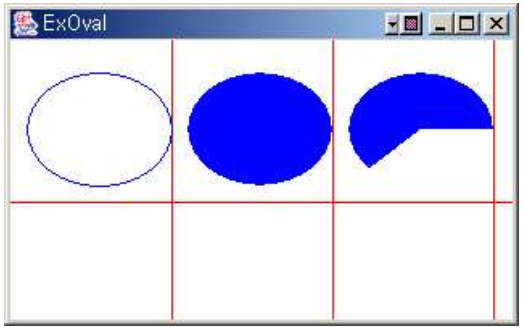
Type of Shape
Line : straight line Rect : rectangle 3Drect : 3-dimensional rectangle RoundRect : rounded rectangle Oval : ellipse Arc : an arc of circle, part of circle Polygon : polygon. Make with joining start point and endpoint



Draw Line

- Draw Line
  - drawLine(int x1, int y1, int x2, int y2)
- Draw rectangle
  - drawRect(int x, int y, int width, int height)
  - draw3DRect(), drawRoundRect(), fillRect()…
- Draw ellipse and elliptical arc
  - Designate rectangle that ellipse will be(inscribed ellipse)
  - Elliptical arc is based on 3 o'clock and angle goes counter clockwise direction





Draw String

- Draw string using method such as drawString()
  - Provide font character with FontMetrics
  - Font have variable width, so letter has difference width

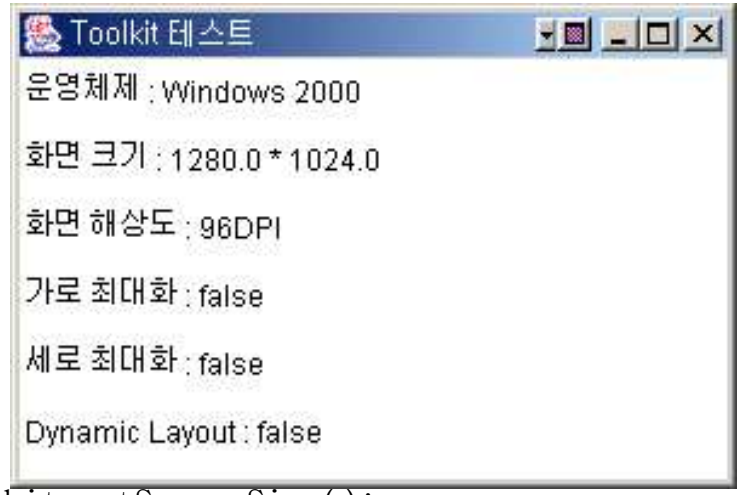
Toolkit Class

- Parent class of AWT GUI toolkit object
  - Create various component of AWT
  - Connect to native component of system
- Abstract Class
  - Get object with Toolkit.getDefaultToolkit or getToolkit method of Component
- getImage() return image object right after call
  - Do not consider whether data is completely ready

java.awt.Toolkit major method		
Dimension	getScreenSize()	Get total screen size
int	getScreenResolution()	Get screen resolution (DPI: dots per inch)
Image	getImage(String filename)	Get image according to filename
Image	getImage(URL url)	Get image according to url

Toolkit Example

- Toolkit example to get a lot of information




```
public void test() {
Toolkit toolkit = getToolkit();  Dimension dim = toolkit.getScreenSize();
toolkit.setDynamicLayout(true);
add(new Label("운영체제 : "+System.getProperty("os.name")));  add(new Label("화면 크기 :
"+dim.getWidth()+" * "+dim.getHeight()));  add(new Label("화면 해상도 :
"+toolkit.getScreenResolution()+"DPI"));
add(new Label("가로 최대화 : "+toolkit.isFrameStateSupported(Frame.MAXIMIZED_HORIZ)));
add(new Label("세로 최대화 : "+toolkit.isFrameStateSupported(Frame.MAXIMIZED_VERT)));
add(new Label("Dynamic Layout : "+toolkit.isDynamicLayoutActive()));
}
```

Draw Image

- drawImage(Image img, int x, int y, Color bgcolor, ImageObserver obs)
  - Fill area to be drawn with bgcolor, and draw image at (x, y) position
- ImageObserver
  - ImageObserver object call imageUpdate() method to draw image after all image date is loaded because size of image resources is big
- Image extension/contraction
  - Image extension and contraction is easy with using argument of drawImage() method

Manage Image Resources

- All Platforms except Java
  - Other tasks are paused until image is loaded
  - Load all data once when creating image object

- Java Platform (asynchronous processing)
  - Method call for image object create return immediately while background thread load image
- Ex) Print process with incomplete image data
  - Excepting Java, Wait for loading all data complete
  - Print process with current image data at java platform

Print Image on the Screen

1. Get name and url of image file
2. Get toolkit object
3. Load image
4. Prepare image(trace)
5. Print image

How to use

```
URL url = getClass().getResource(file_name);
Toolkit toolkit = Toolkit.getDefaultToolkit();  Image
img = toolkit.getImage(url);
```

Context of constructor

```
URL url = new URL("http://java.sun.com/docs/books/tutorial/images/wood8.GIF");
imgExample = getToolkit().getImage(url);
```

Paint method

```
public void paint(Graphics g){
if (
getToolkit().prepareImage(imgExample, -1, -1, this) == false
) {
g.drawString("Wait for Loading", 100, 100);
} else {
g.drawImage(imgExample, 10, 10, this);
}
}
```

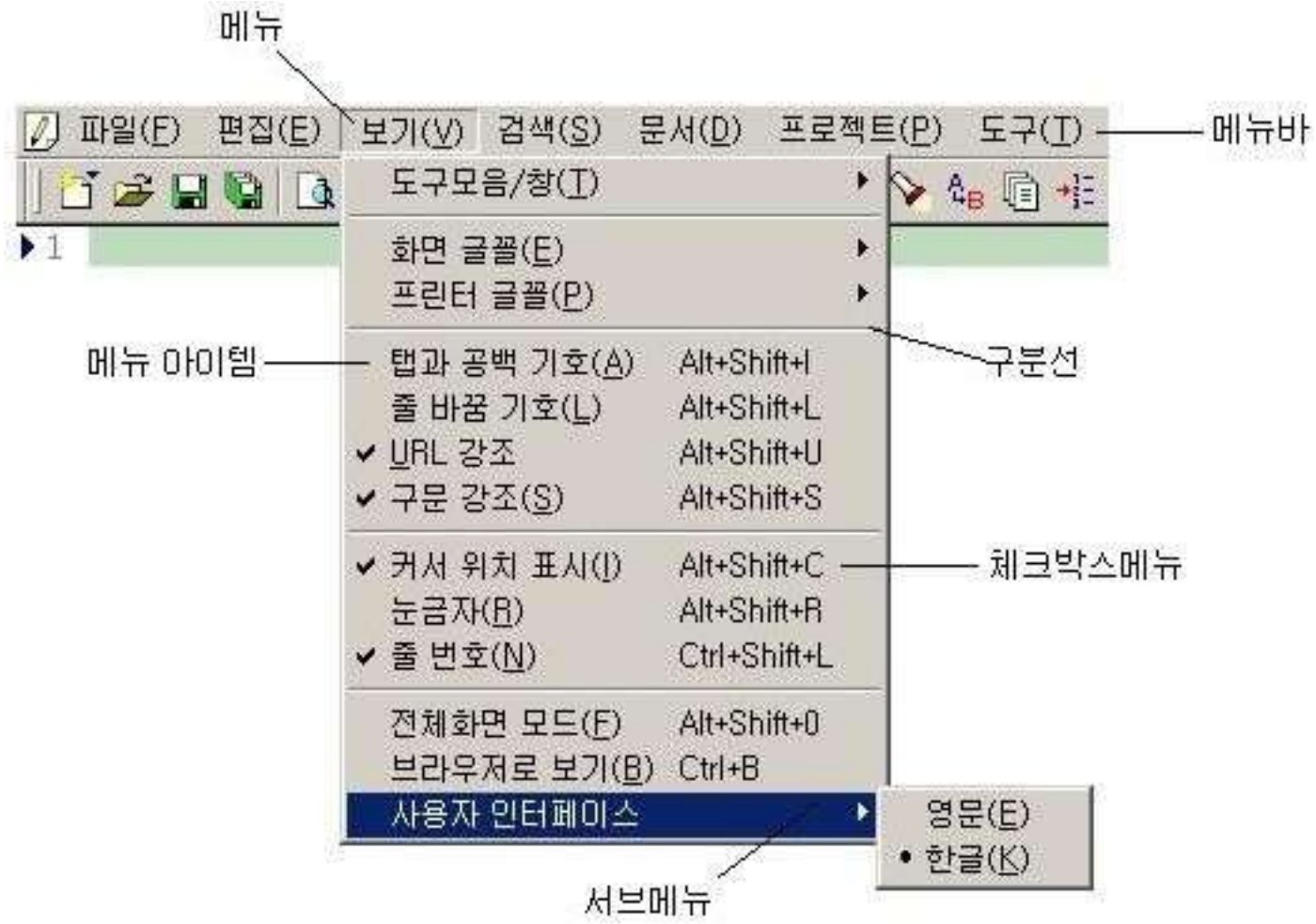
Create Image Button

- Make button more visual by inserting image

ImageButton.java

```
public void paint(Graphics g){
if (xImage == null) super.paint(g);  else {
/* draw image at the center of button. */  g.drawImage(
xImage
, (getWidth() - xImage.getWidth(this)) /2
, (getHeight() - xImage.getHeight(this)) /2
, this
);
}
```

Organization of menu



How to Make Menu

1. Create menu bar to attaching menu

   MenuBar myMenuBar= new MenuBar();

2. Create menu

   Menu myMenu= new Menu("내 메뉴");

3. Create menu item and add in menu

   MenuItem myMenuItem= new MenuItem("내 아이템");
   myMenu.add(myMenuItem);

4. Add menu in menu bar

   myMenuBar.add(myMenu);

5. Set menu bar at frame

   Frame myFrame= new Frame();
   myFrame.setMenuBar(myMenuBar);

Checkbox menu

```
...
Menu myMenu= new Menu("내 메뉴");
CheckboxMenuItem myCheckboxMenuItem
                    = new  CheckboxMenuItem("내 체크박스메뉴");
myMenu.add(myCheckboxMenuItem);
...
```

•Use CheckboxMenuItem
instead of MenuItem

Sub menu

```
...
Menu myMenu= new Menu("내 메뉴");
Menu mySubMenu= new Menu("내 서브메뉴");
MenuItem mySubMenuItem
                        = new MenuItem("내 서브메뉴 아이템  ");
mySubMenu.add(mySubMenuItem);
myMenu.add(mySubMenu);
...
```

•Use Menu instead of MenuItem