

# INTRODUCTION

CMPT 381

# Outline

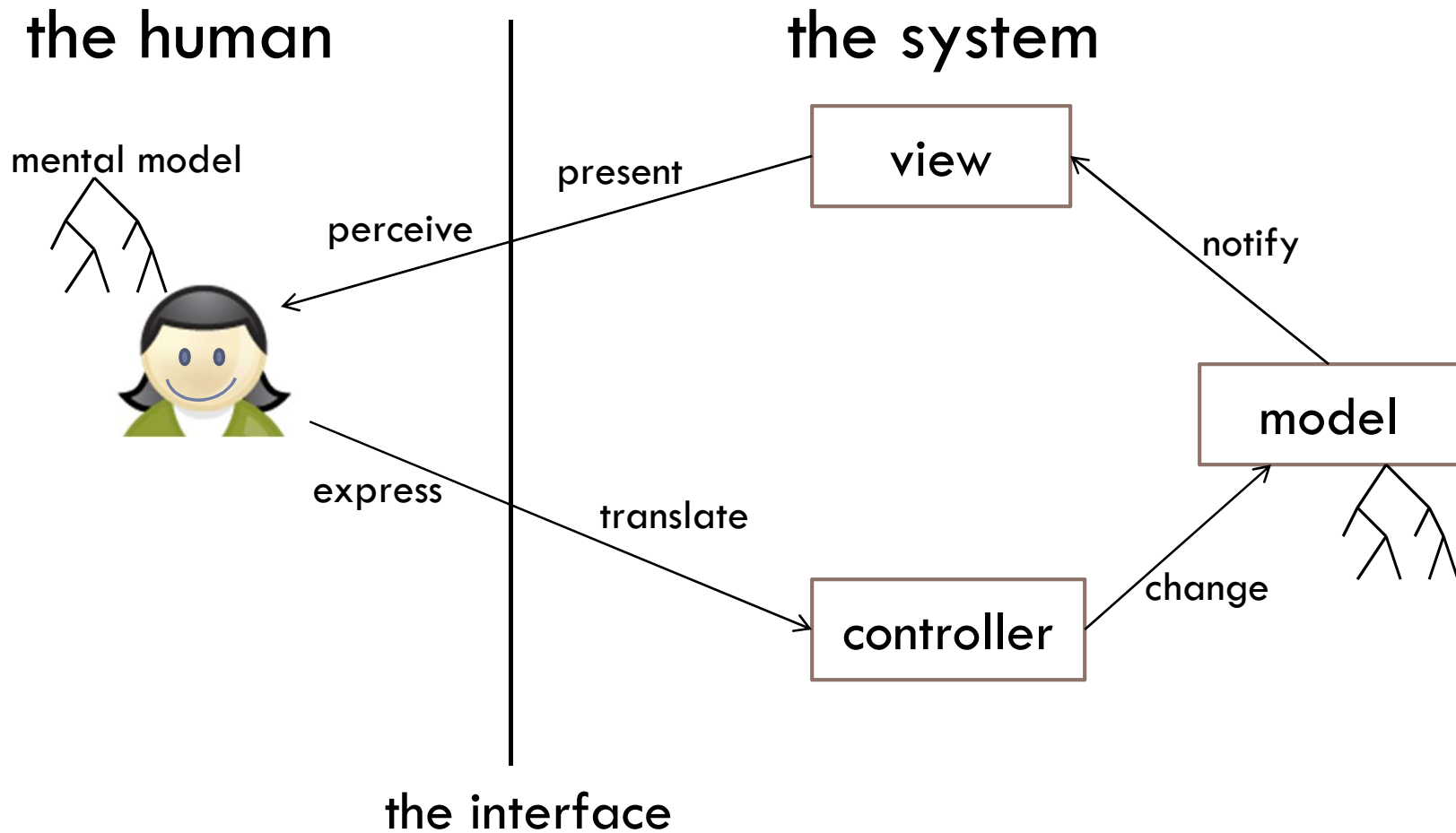
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- The interaction cycle
- Parts of a Graphical User Interface
- A layered approach to supporting interaction
- Development basics

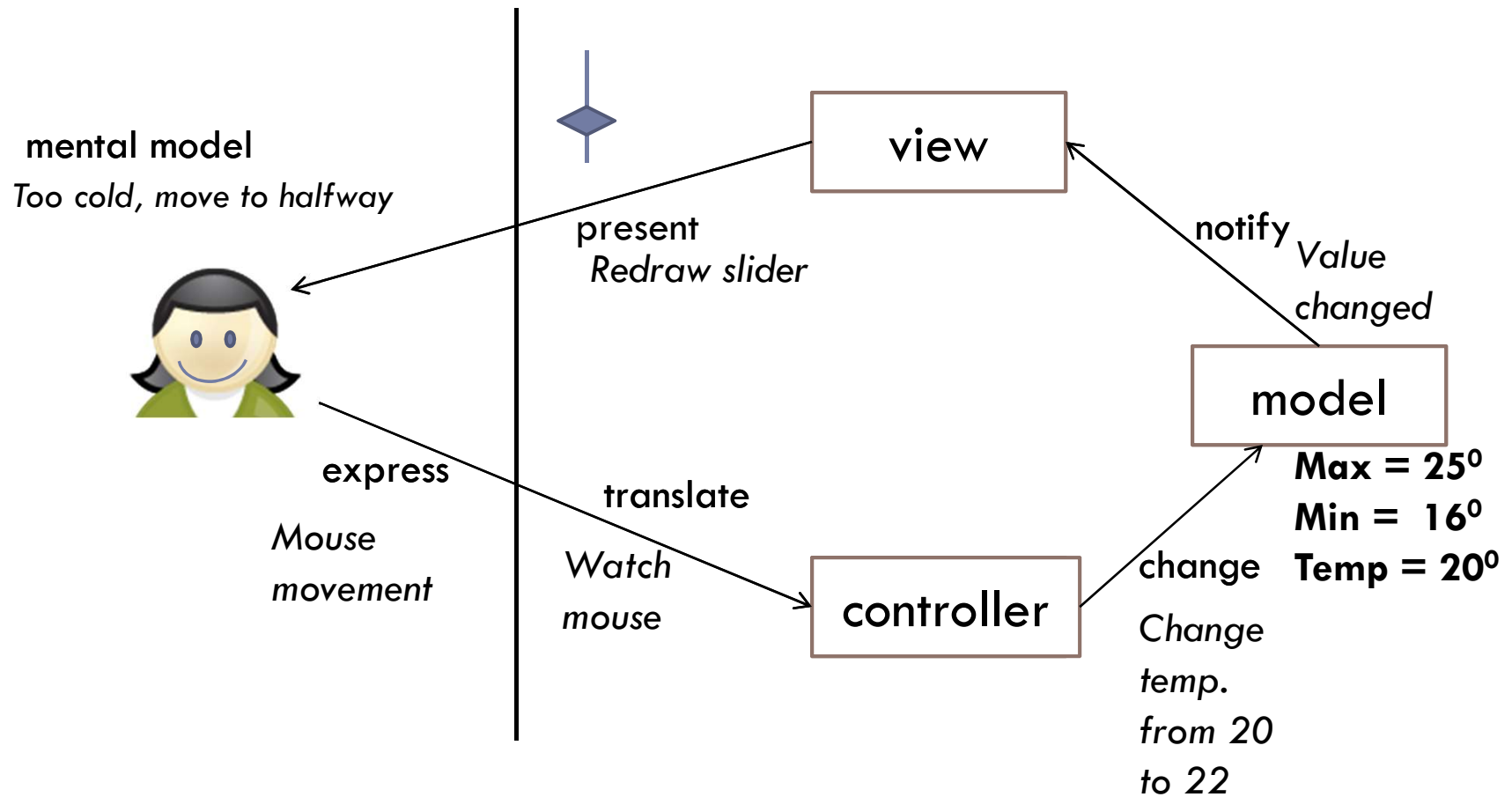


# The Interaction Cycle

# Architecture of interactive systems



# Example: software thermostat





# The GUI

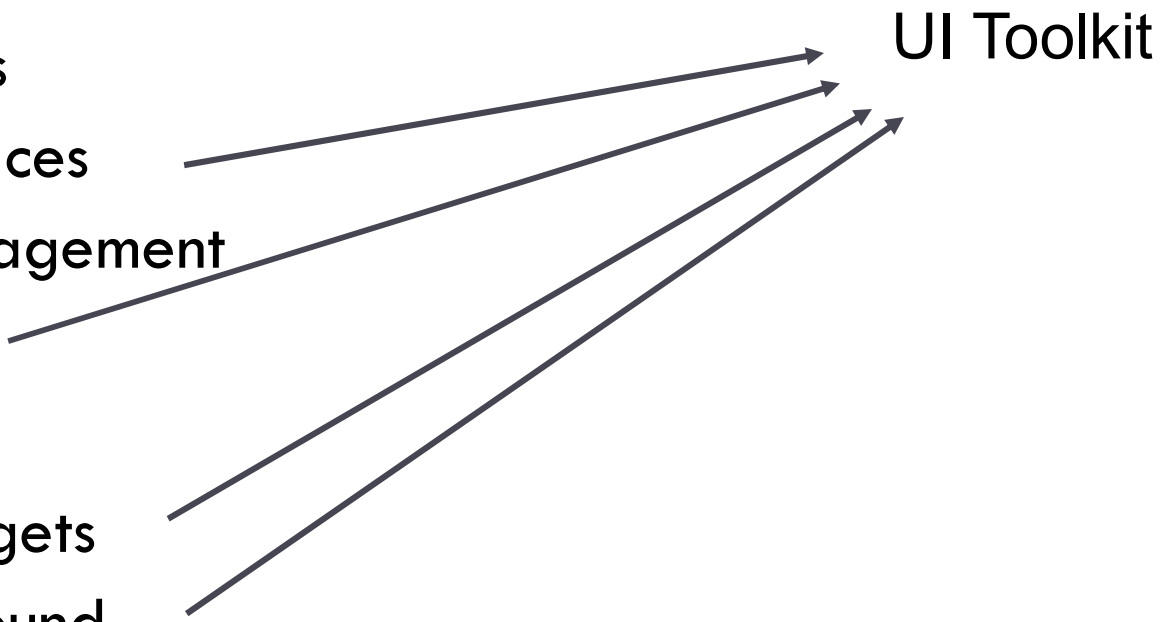
# Parts of a GUI

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- Input side:
  - Input devices
  - Device drivers
  - Device interfaces
  - Window management
  - Input events
- Output side:
  - Interface widgets
  - Graphics & sound
  - Display/output devices

# Parts of a GUI

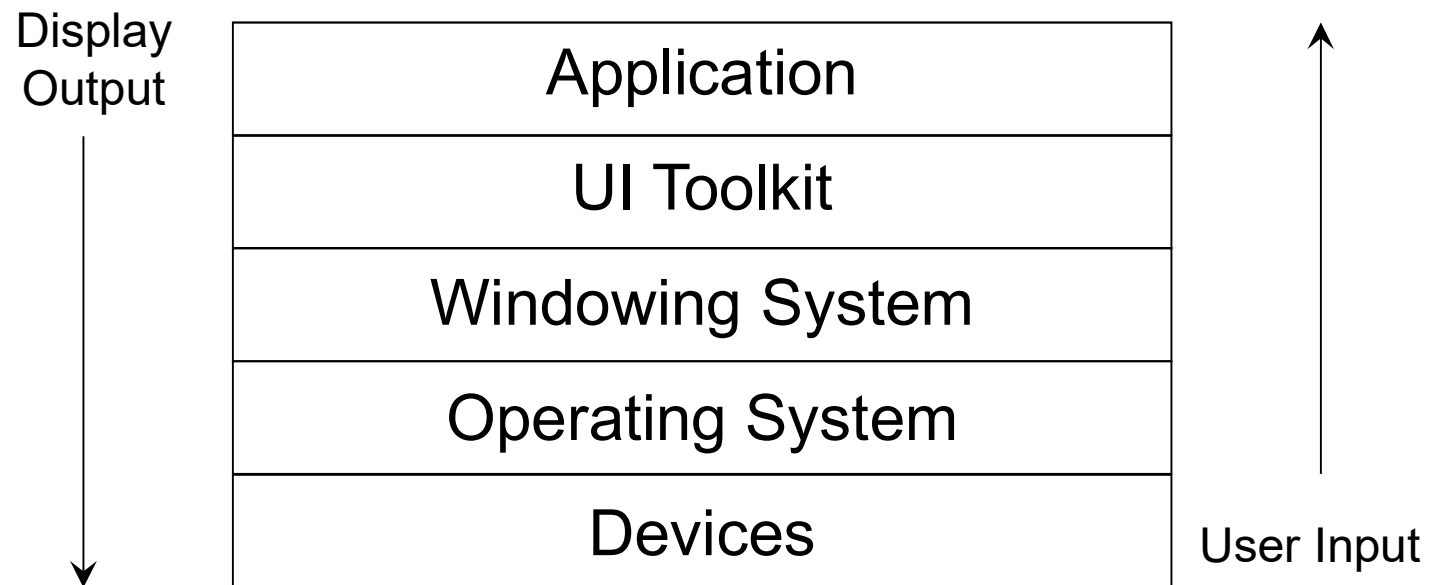
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- Input side:
    - Input devices
    - Device drivers
    - Device interfaces
    - Window management
    - Input events
  - Output side:
    - Interface widgets
    - Graphics & sound
    - Display/output devices
- 
- The diagram illustrates the flow of data between the GUI components and the UI Toolkit. Four arrows point from the input and output components to the UI Toolkit:
- An arrow from "Device interfaces" to the UI Toolkit.
  - An arrow from "Input events" to the UI Toolkit.
  - An arrow from "Interface widgets" to the UI Toolkit.
  - An arrow from "Graphics & sound" to the UI Toolkit.
- The text "UI Toolkit" is positioned to the right of the arrows, indicating it is the central component that receives input and manages output.



# Layered Approach

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# Layered Approach

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- Device layer
  - Hardware level for input and output devices
  - Device drivers communicate with the OS
- OS layer
  - Turns input signals into events and sends to applications
  - Provides graphics/sound API
    - low-level machine-optimized drawing routines
    - e.g. Windows API, Macintosh Toolbox, X Intrinsics

# Layered Approach

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- Windowing system layer
  - puts applications in separate windows
  - handles resize, close, and iconify events
  - enforces a presentation style
- UI Toolkit layer
  - provides a set of high-level interface components
    - in Java, AWT (old) or FX (new)
    - in Android, no specific name (part of Android SDK)
  - handles input events
  - provides support for widget layout and graphics

# Layered Approach

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- Application layer
  - decides what to do with user input
  - manipulates the UI widgets
  - controls custom repainting of the screen
- Programmer only has to deal with the application and toolkit layers
  - (you can also talk to the window manager)

# Layered Approach

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- Layers are similar for all platforms (desktop, mobile, wearable, wall display)
  - The specific capabilities of the UI toolkit will be different, but the basic ideas are similar

# Window System

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- Controls mouse, keyboard, monitor settings
- Provides windows for applications
  - Keeps a map of what application is where
- Dispatches input to different windows
  - Uses the map to decide who to inform

# Window Manager

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- Controls how windows look and act
  - Window decoration, Title bar
  - Window switching, virtual desktops
  - (Note that a 'Desktop' is not the same as the WM; it is an application)
- Microsoft Windows:
  - Combines OS, Window System, Window Manager, and Desktop

# Examples

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- 3D Window Managers
  - Metisse
  - <https://www.youtube.com/watch?v=Dt3q7Z7RjIU>
- Material Design UI toolkit
  - <https://material.io/design/introduction/>





# Programming the UI

# Development Environments

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- JavaFX
  - Java 11 SDK, IntelliJ IDE
    - <https://openjfx.io/>
- Android
  - Java 8 SDK, Android Studio IDE
    - <https://developer.android.com/studio/>

# Hello World in JavaFX

```
import ...

public class HelloWorld extends Application {

    public void start(Stage primaryStage) {
        Button btn = new Button("Say Hello ");
        btn.setOnAction((ActionEvent event) -> {
            System.out.println("Hello!");
        });

        StackPane root = new StackPane();
        root.getChildren().add(btn);

        Scene scene = new Scene(root, 300, 250);
        primaryStage.setScene(scene);
        primaryStage.show();
    }

    public static void main(String[] args) {
        launch(args);
    }
}
```

# Hello World in Android (1)

```
<RelativeLayout xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:paddingLeft="@dimen/activity_horizontal_margin"
    android:paddingRight="@dimen/activity_horizontal_margin"
    android:paddingTop="@dimen/activity_vertical_margin"
    android:paddingBottom="@dimen/activity_vertical_margin"
    tools:context=".HelloWorldActivity">

    <TextView android:text="@string/hello_world"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content" />

</RelativeLayout>
```

# Hello World in Android (2)

```
import ...

public class HelloWorldActivity extends Activity {

    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_hello_world);
    }

    public boolean onCreateOptionsMenu(Menu menu) {
        getMenuInflater().inflate(R.menu.menu_hello_world, menu);
        return true;
    }

    public boolean onOptionsItemSelected(MenuItem item) {
        int id = item.getItemId();
        if (id == R.id.action_settings) {
            return true;
        }
        return super.onOptionsItemSelected(item);
    }
}
```

# Hello World in Android (3)

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Plus many more files:

```
app/src/main/res/layout/activity_my.xml
app/src/res/AndroidManifest.xml
app/build.gradle
/res/drawable-hdpi/
/res/layout/
/res/values/
```

# Hello World in Tcl/Tk

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```
pack [button .b -text "Say Hello" -command "puts Hello"]
```

# Homework

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- Work with your environments
  - Hello-world assignment due next week
- Online tutorials, e-books from U of S library
- Textbook:
  - Chapter 1 (overview)
  - Chapter 2 (graphics)
  - Chapter 4 (widgets)