MVC and Android

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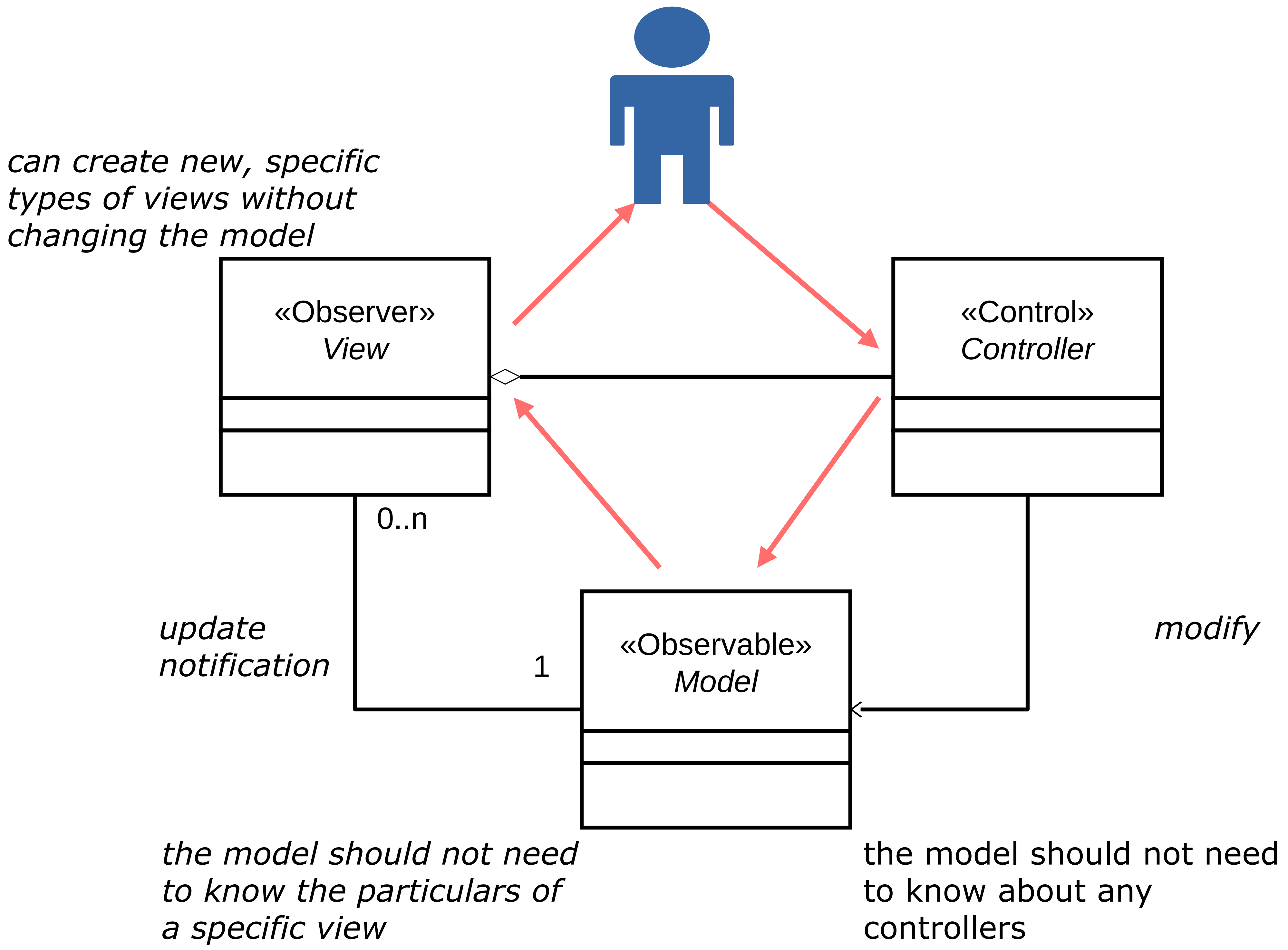
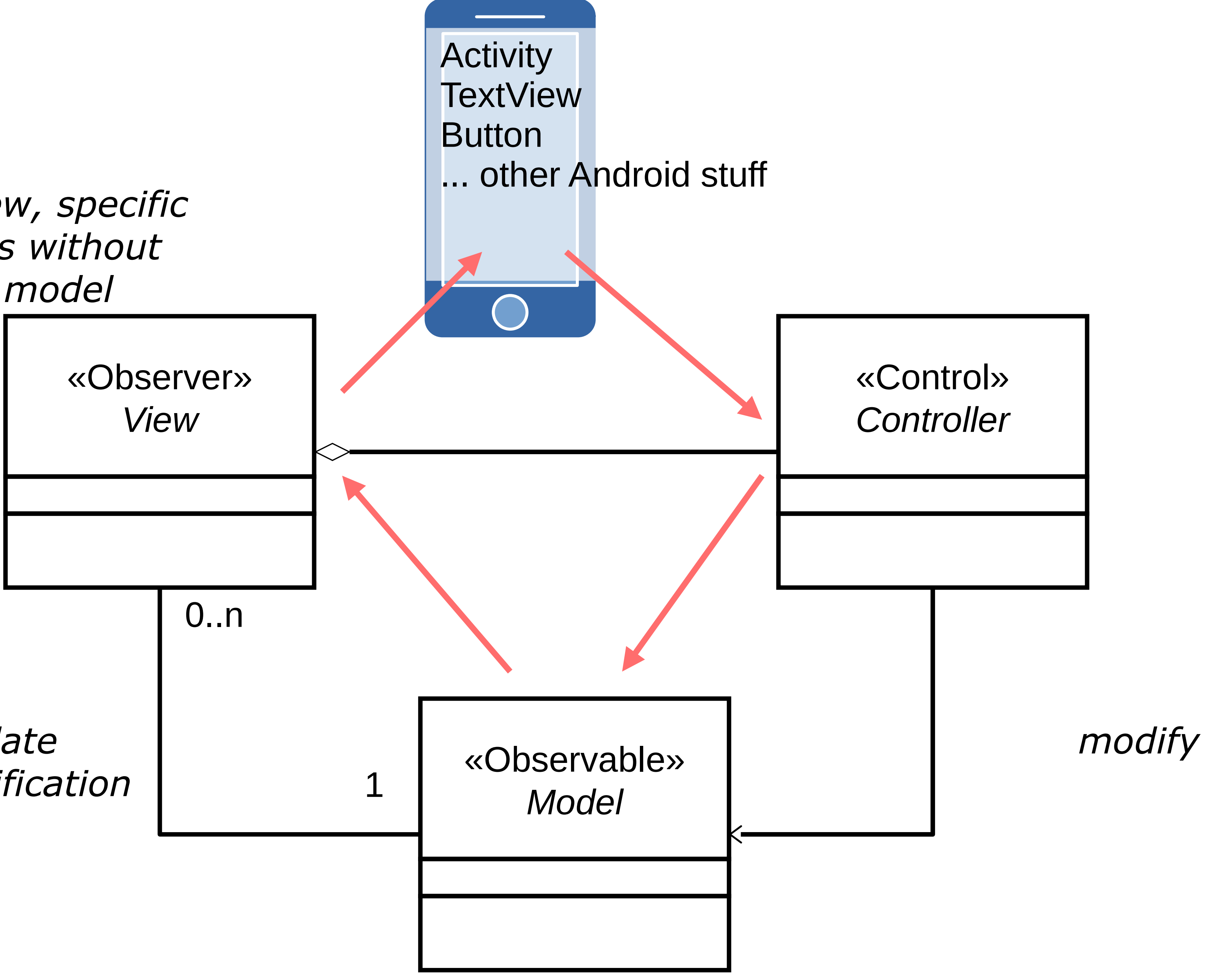

can create new, specific types of views without changing the model
«Observer» View
«Control» Controller
0..n
update notification
1
«Observable» Model
modify
the model should not need to know the particulars of a specific view
the model should not need to know about any controllers



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update notification

modify

the model should not need to know the particulars of a specific view

the model should not need to know about any controllers

MVC Classes

- Model Classes
  - Entities (“Book”, “Library”, “Password”)
  - complete, self-contained representation of the data managed by the application
  - What you would save!
  - Evolves over time
  - Enforces consistency and validity rules
  - Lots of setters and getters!

MVC Classes

- Model Classes
  - Enforces consistency and validity rules
    - Enforce multiplicities
    - Enforce composition relationship
    - Enforce positive numbers are positive
    - Enforce passwords have at least one number and a special symbol…

MVC Classes

- Model Classes
  - These classes get saved to file…
    - Or stored in database
    - Or mapped to database with ORM
    - Or sent over the internet

- Has add/remove(observer) methods.
- Calls update(this) on all the observers when the model data changes!

MVC Classes

- View Classes
  - Boundary Layer
  - Presentation Layer
  - Talk to the toolkit
    - Android: Activities, Fragments, ListViews, etc.
  - Main responsibility
    - Presentation issues!

MVC Classes

- View Classes
  - Main responsibility
    - Presentation issues!
      - Format a timestamp 1727381284 -> “Thu 26 Sep 2024 02:08:04 PM MDT”
      - Make sure lists are sorted if we want them sorted in the UI
      - person.getFirstName() + “ “ + person.getLastName()

MVC Classes

- View Classes
  - Has a reference to the Model class so it can call lots of getters.
  - model.addView(this) in the constructor.
    - (Observer pattern!)

MVC Classes

- Controller Classes
  - Boundary Layer
  - Presentation Layer
  - Handle Events
  - Talk to the toolkit
    - Android: Activities, Fragments, ListViews, etc.
  - Main responsibility
    - Transforming input into the format the Model wants

MVC Classes

- Controller Classes
  - Main responsibility
    - Transforming input into the format the Model wants
    - Parse a timestamp “Thu 26 Sep 2024 02:08:04 PM MDT” -> 1727381284
    - Split firstName and lastName

MVC Classes

- Controller Classes
  - Has a reference to the Model class so it can call lots of setters.
  - Generally constructed with the model it’s meant to control.

Observer Pattern

```
public abstract class AbstractObservable {
    private final transient Set<AbstractObserver> observers;

    protected AbstractObservable() {
        observers = new ArraySet<>();
    }

    public void addObserver(AbstractObserver observer) {
        observers.add(observer);
        observer.update(this);
    }

    public void removeObserver(AbstractObserver observer) {
        observers.remove(observer);
    }

    public void notifyObservers() {
        // Call this from setters
        for (AbstractObserver observer : observers) {
            observer.update(this);
        }
    }
}
```

Observer Pattern

```
public abstract class AbstractObserver {
    public transient AbstractObservable observable;

    public void startObserving(AbstractObservable observable) {
        // call me from the constructor or when ready
        if (this.observable != null) {
            throw new RuntimeException("Can't view two models!");
        }
        this.observable = observable;
        observable.addObserver(this);
    }

    public void stopObserving() {
        // call me from delete() or close() etc.
        observable.removeObserver(this);
        this.observable = null;
    }

    public abstract void update(AbstractObservable whoUpdatedMe);
}
```

Abstract Model Class

```
public abstract class AbstractModel {
    private final transient Set<AbstractView> views;

    protected AbstractModel() {
        views = new ArraySet<>();
    }

    public void addView(AbstractView view) {
        views.add(view);
        view.update(this);
    }

    public void removeView(AbstractView view) {
        views.remove(view);
    }

    public void notifyViews() {
        // Call this from setters
        for (AbstractView view : views) {
            view.update(this);
        }
    }
}
```

Abstract View Class

```
public abstract class AbstractView {
    private AbstractModel model;

    public void startObserving(AbstractModel model) {
        // called during the constructor ...
        // ... or when its ready to start getting updates
        if (this.model != null) {
            throw new RuntimeException("Can't view two models!");
        }
        this.model = model;
        model.addView(this);
    }

    public void closeView() {
        // when the view goes away
        model.removeView(this);
        this.model = null;
    }

    public abstract void update(AbstractModel whoUpdatedMe);

    public AbstractModel getModel() {
        return model;
    }
}
```

Abstract Controller Class

```
public abstract class AbstractController {
    private final AbstractModel model;

    public AbstractController(AbstractModel model) {
        this.model = model;
    }

    public AbstractModel getModel() {
        return model;
    }
}
```

Concrete Model Class

```
public class TimerModel extends AbstractModel {
    /* this is our actual model stuff */
    private long startTime;
    private long duration;
    private boolean running;

    public void updateDuration() {
        duration = System.currentTimeMillis() - startTime;
        notifyViews();
    }
    public long getDuration() {
        return duration;
    }
    public boolean isRunning() {
        return running;
    }
    public void startTimer() {
        if (running) {
            throw new RuntimeException("Already running!");
        }
        startTime = System.currentTimeMillis();
        running = true;
        updateDuration();
        scheduleUpdate();
    }
    public void stopTimer() {
        if (!running) {
            throw new RuntimeException("Not running!");
        }
        running = false;
        scheduled.cancel(false);
        notifyViews();
    }
```

Concrete Model Class - Evolution

```
  /* This stuff is just for updating the duration over time (evolution)
*/
    private ScheduledFuture<?> scheduled;
    private final ScheduledExecutorService scheduler  =
Executors.newScheduledThreadPool(1);;
    private final Runnable updater = new Runnable() {
        @Override
        public void run() {
            updateDuration();
            if (running) {
                scheduleUpdate();
            }
        }
    };

    private void scheduleUpdate()
    {
        scheduled = scheduler.schedule(updater, 1, TimeUnit.SECONDS);
    }
}
```

Concrete View Class

```java
public class TimerView extends AbstractView {
    private final MainActivity mainActivity;

    public TimerView(TimerModel model, MainActivity mainActivity) {
        this.mainActivity = mainActivity;
        this.startObserving(model);
    }
    @Override
    public TimerModel getModel() {
        // Dangerous downcast!
        return (TimerModel) super.getModel();
    }
    @Override
    public void update(AbstractModel whoUpdatedMe) {
        if (getModel().isRunning()) {
            long duration = getModel().getDuration();
            long ms = duration % 1000;
            long seconds = duration / 1000 % 60;
            long minutes = duration / 1000 / 60;
            String stringDuration =
                   String.format("%dm %02ds %03dms", minutes, seconds, ms);
            mainActivity.showDuration(stringDuration);
        } else {
            mainActivity.showDuration("Timer Stopped");
        }
    }
}
```

Concrete Controller Class

```
public class TimerController extends AbstractController {
    public TimerController(TimerModel model) {
        super(model);
    }

    @Override
    public TimerModel getModel() {
        return (TimerModel) super.getModel();
    }

    public void stopButtonPressed() {
        if (getModel().isRunning()) {
            getModel().stopTimer();
        }
    }

    public void startButtonPressed() {
        if (!getModel().isRunning()) {
            getModel().startTimer();
        }
    }
}
```

Android Activity

```
public class MainActivity extends AppCompatActivity {

    private AppBarConfiguration appBarConfiguration;
    private ActivityMainBinding binding;
    private TimerView view;
    private TimerController controller;

    public void showDuration(String message) {
        // We could've been on the timer model's update thread!
        // So we have to return to the UI thread.
        runOnUiThread(new Runnable() {
            @Override
            public void run() {
                binding.timeTextView.setText(message);
            }
        });
    }
```

Android Activity onCreate

```
@Override
protected void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);

    binding = ActivityMainBinding.inflate(getLayoutInflater());
    setContentView(binding.getRoot());

    showDuration("Loading...");

    TimerModel model = new TimerModel();
    view = new TimerView(model, this);
    controller = new TimerController(model);

    binding.startButton.setOnClickListener(new View.OnClickListener() {
        @Override
        public void onClick(View view) {
            controller.startButtonPressed();
        }
    });

    binding.stopButton.setOnClickListener(new View.OnClickListener() {
        @Override
        public void onClick(View view) {
            controller.stopButtonPressed();
        }
    });
}
```