



Android

Application Development

Lab 3 - Ασκήσεις μελέτης B2

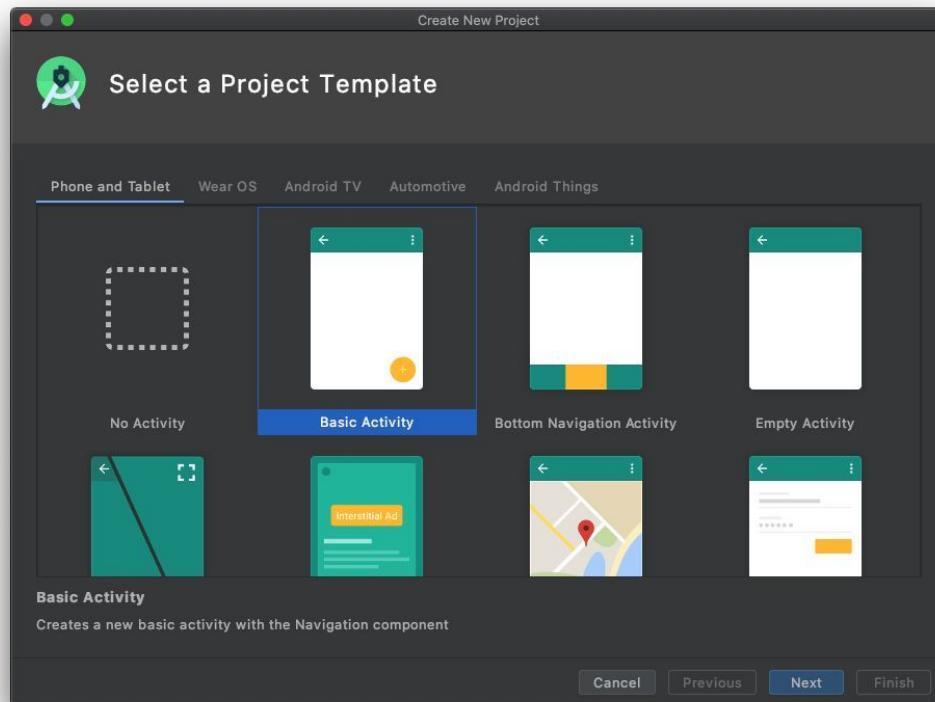
Human-Computer Interaction, AUEB
Εαρινό εξάμηνο 2024-2025

Lab Assistant: Sofia Eleftheriou

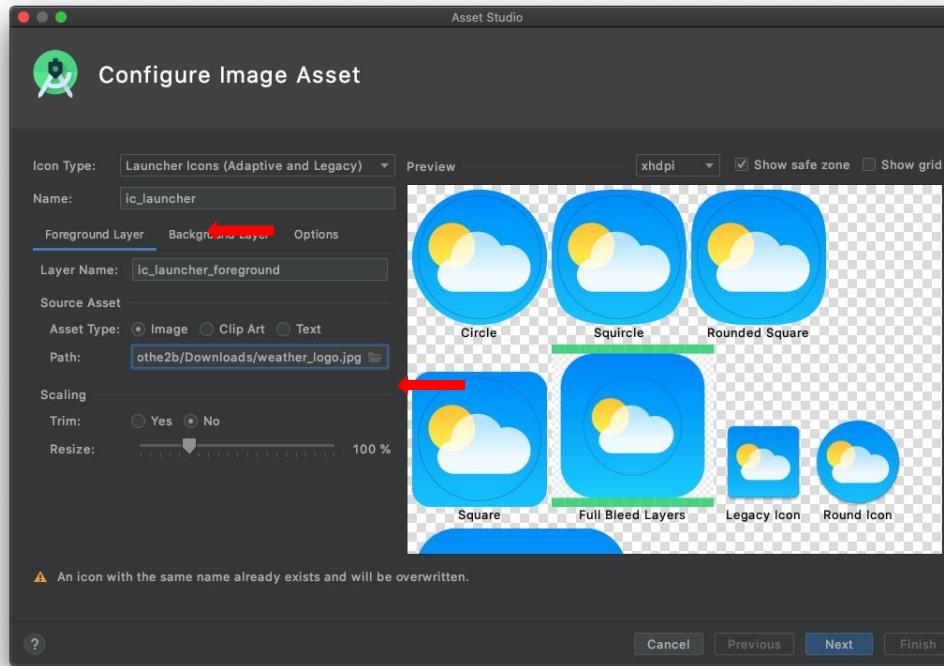
Android Development Advanced Use

- Catch up with Lab 1-2
- Add Voice Recognition functionality
 - Update Business Logic to use voice commands
 - Demonstrate updates

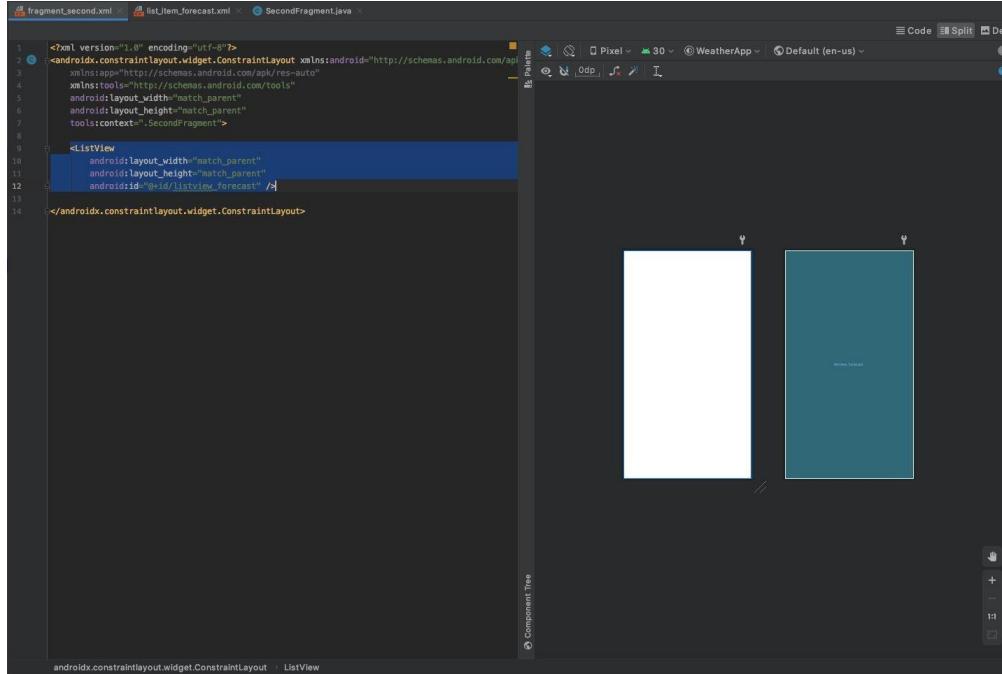
Catch up with Lab 1



Create new project with Basic Activity



Change Application Icon



```
<?xml version="1.0" encoding="utf-8"?>
<androidx.constraintlayout.widget.ConstraintLayout xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:app="http://schemas.android.com/apk/res-auto"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    tools:context=".SecondFragment">

    <ListView
        android:layout_width="match_parent"
        android:layout_height="match_parent"
        android:id="@+id/listView_forecast" />

</androidx.constraintlayout.widget.ConstraintLayout>
```

Add ListView to layout

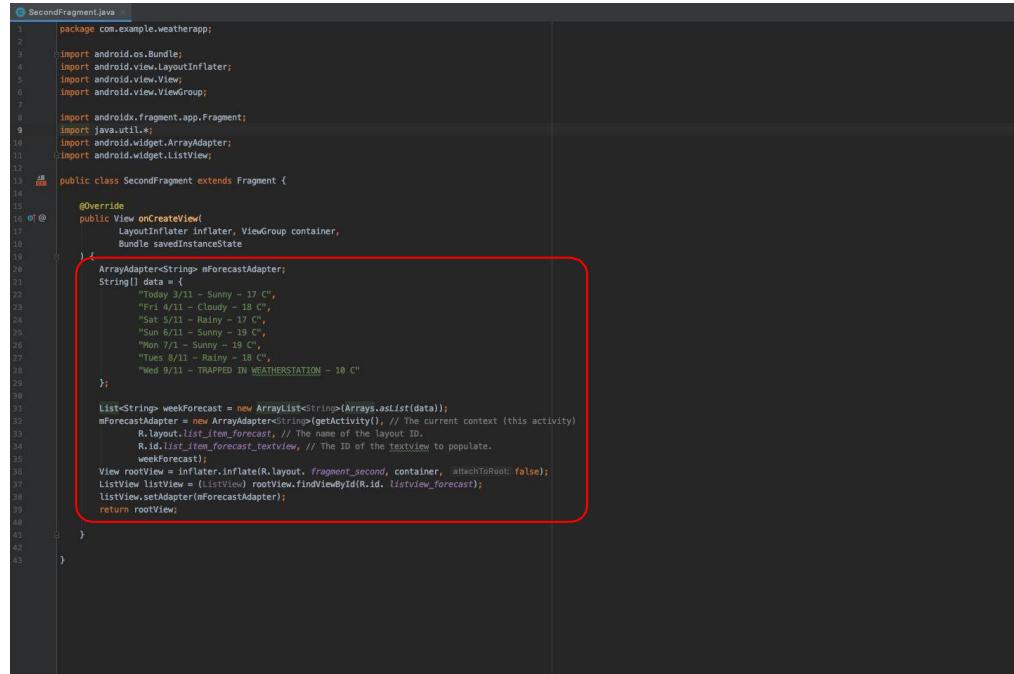
The screenshot shows the Android Studio interface with two XML files open:

- `fragment_second.xml`: Contains a single `ConstraintLayout` with a white background.
- `list_item_forecast.xml`: Contains a `ConstraintLayout` with a teal background. Inside it is a `TextView` with the ID `@+id/list_item_forecast_textview`.

In the Design tab, there are two views displayed side-by-side. The left view is white, and the right view is teal. The bottom navigation bar shows the following icons: Component Tree, Attributes, and a magnifying glass icon.

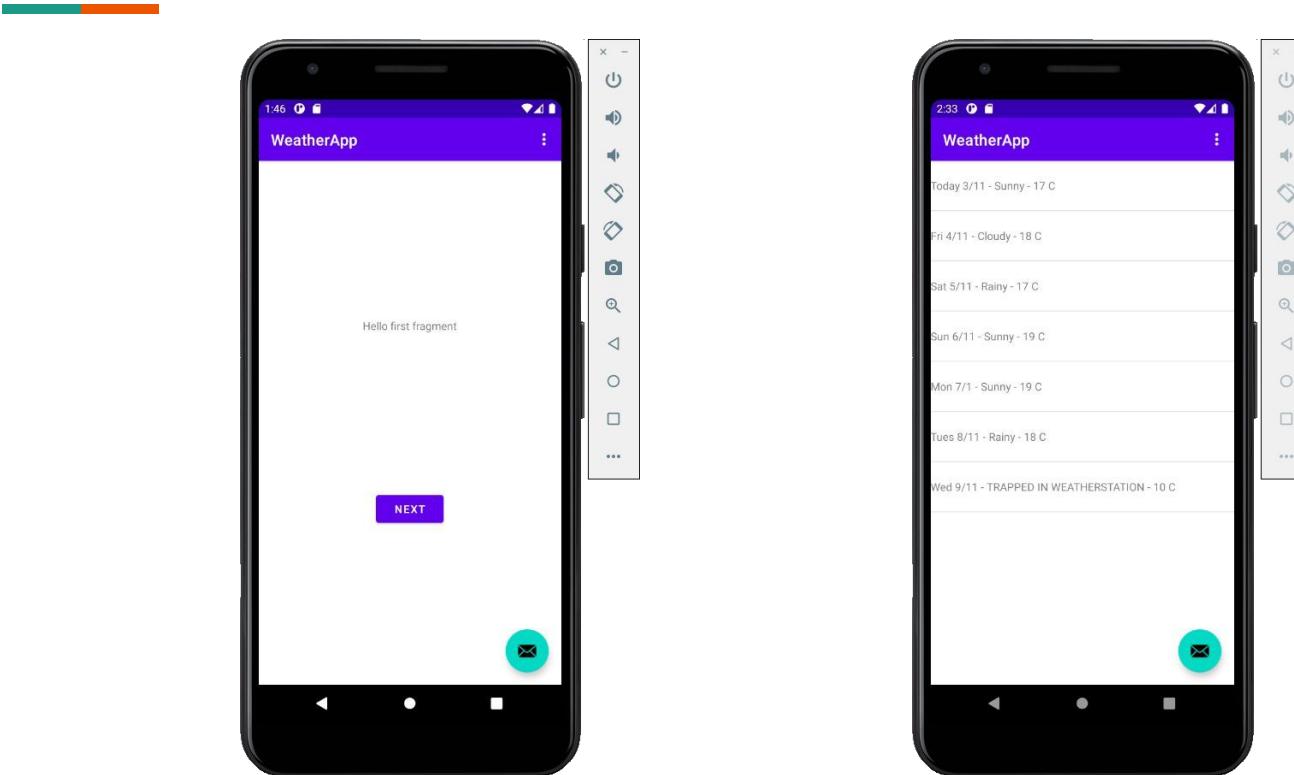
```
<?xml version="1.0" encoding="utf-8"?>
<androidx.constraintlayout.widget.ConstraintLayout
    xmlns:android="http://schemas.android.com/apk/res/android" android:layout_width="match_parent"
    android:layout_height="match_parent">
    <TextView android:id="@+id/list_item_forecast_textview"
        android:layout_width="match_parent" android:layout_height="match_parent"
        android:minHeight="?android:attr/listPreferredItemHeight"
        android:gravity="center_vertical"
        android:id="@+id/list_item_forecast_textview">
    </TextView>
</androidx.constraintlayout.widget.ConstraintLayout>
```

Add new layout with `TextView` for list items

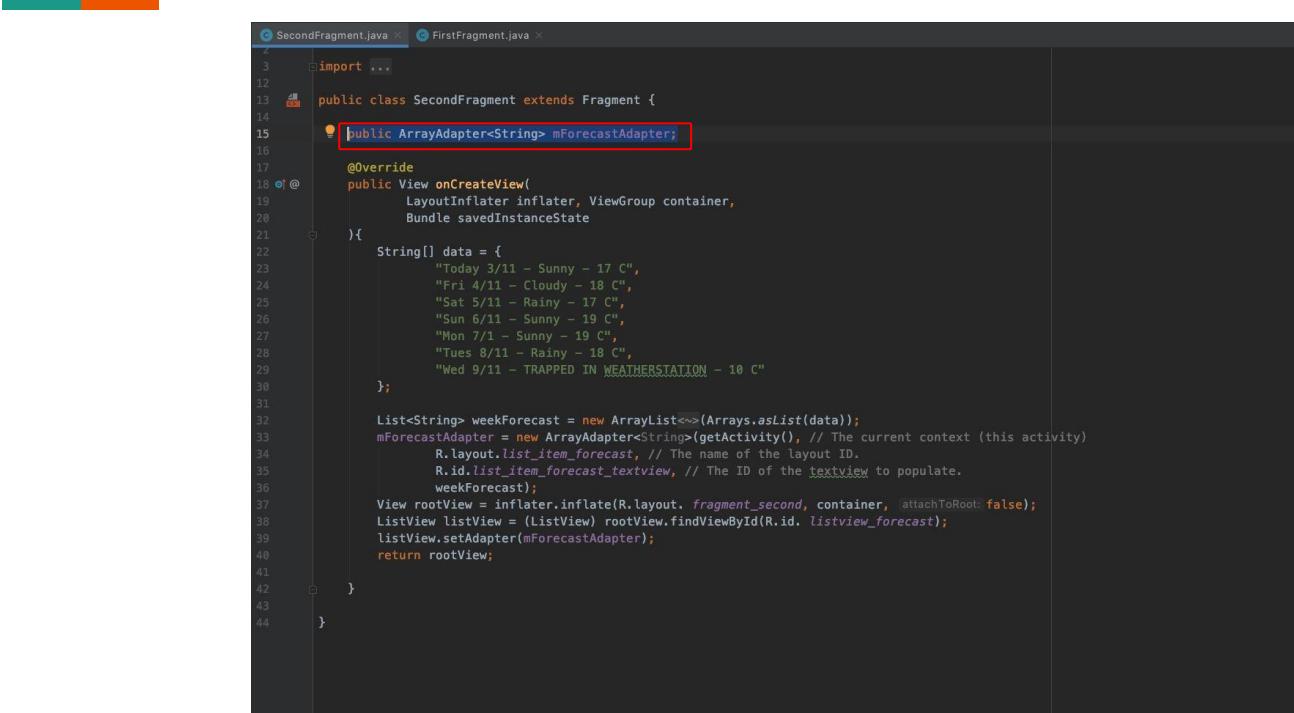


```
SecondFragment.java
1 package com.example.weatherapp;
2
3 import android.os.Bundle;
4 import android.view.LayoutInflater;
5 import android.view.View;
6 import android.view.ViewGroup;
7
8 import androidx.fragment.app.Fragment;
9 import java.util.*;
10 import android.widget.ArrayAdapter;
11 import android.widget.ListView;
12
13 public class SecondFragment extends Fragment {
14
15     @Override
16     public View onCreateView(
17             LayoutInflater inflater, ViewGroup container,
18             Bundle savedInstanceState
19     ) {
20         ArrayAdapter<String> mForecastAdapter;
21         String[] data = {
22             "Today 3/11 - Sunny - 17 C",
23             "Fri 4/11 - Cloudy - 18 C",
24             "Sat 5/11 - Rainy - 17 C",
25             "Sun 6/11 - Sunny - 19 C",
26             "Mon 7/11 - Sunny - 19 C",
27             "Tue 8/11 - Rainy - 18 C",
28             "Wed 9/11 - TRAPPED IN WEATHERSTATION - 10 C"
29         };
30
31         List<String> weekForecast = new ArrayList<String>(Arrays.asList(data));
32         mForecastAdapter = new ArrayAdapter<String>(getActivity(), // The current context (this activity)
33             R.layout.list_item_forecast, // The name of the layout ID.
34             R.id.list_item_forecast_textview // The ID of the TextView to populate.
35         );
36         weekForecast.setAdapter(mForecastAdapter);
37
38         View rootView = inflater.inflate(R.layout.fragment_second, container, false);
39         ListView listView = (ListView) rootView.findViewById(R.id.listView_forecast);
40         listView.setAdapter(mForecastAdapter);
41         return rootView;
42     }
43 }
```

New business logic / Populate list with mock (fake) data



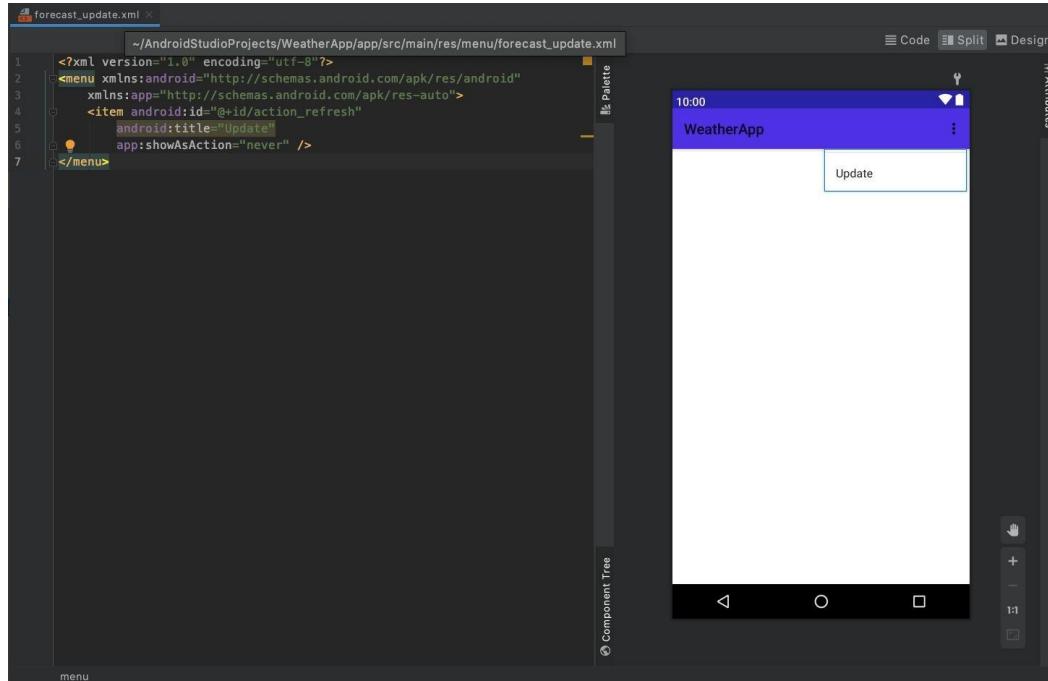
Catch up with Lab 2



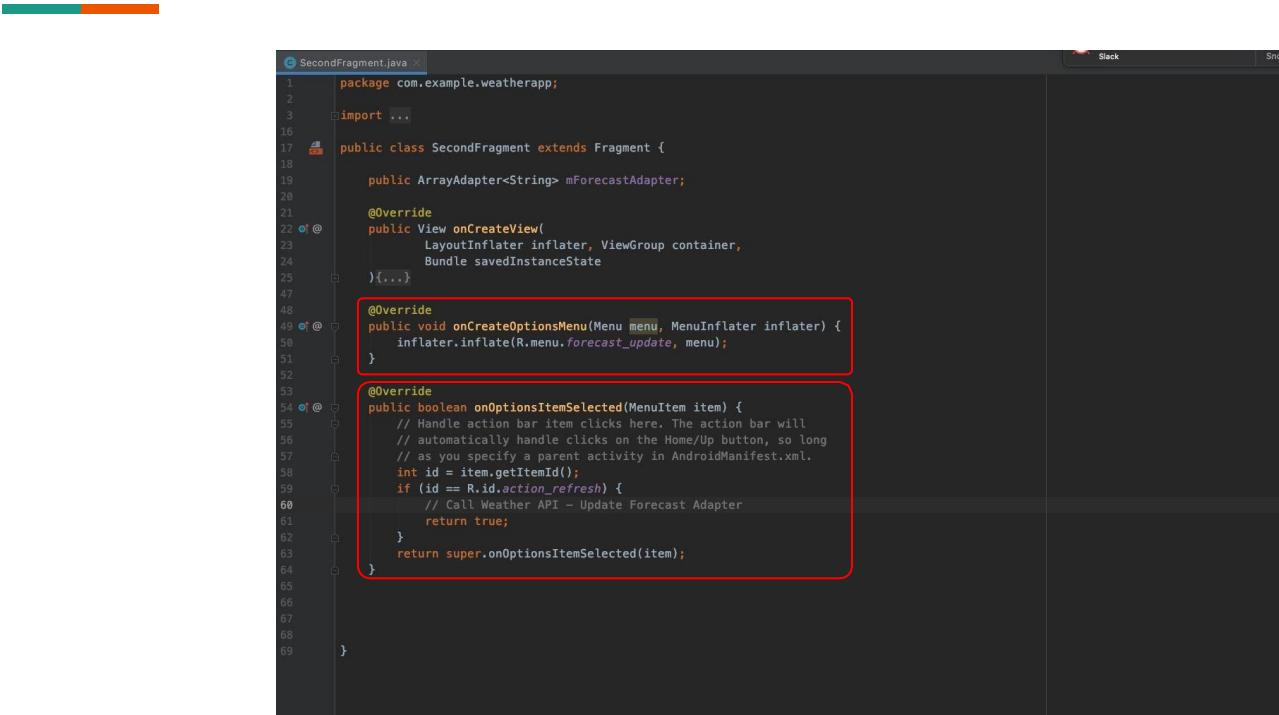
```
SecondFragment.java x FirstFragment.java x

3 import ...
4
5 public class SecondFragment extends Fragment {
6
7     public ArrayAdapter<String> mForecastAdapter;
8
9     @Override
10    public View onCreateView(
11        LayoutInflater inflater, ViewGroup container,
12        Bundle savedInstanceState
13    ){
14        String[] data = {
15            "Today 3/11 - Sunny - 17 C",
16            "Fri 4/11 - Cloudy - 18 C",
17            "Sat 5/11 - Rainy - 17 C",
18            "Sun 6/11 - Sunny - 19 C",
19            "Mon 7/1 - Sunny - 19 C",
20            "Tues 8/11 - Rainy - 18 C",
21            "Wed 9/11 - TRAPPED IN WEATHERSTATION - 10 C"
22        };
23
24        List<String> weekForecast = new ArrayList<>(Arrays.asList(data));
25        mForecastAdapter = new ArrayAdapter<String>(getActivity(), // The current context (this activity)
26            R.layout.list_item_forecast, // The name of the layout ID.
27            R.id.list_item_forecast_textview, // The ID of the textview to populate.
28            weekForecast);
29        View rootView = inflater.inflate(R.layout.fragment_second, container, attachToRoot: false);
30        ListView listView = (ListView) rootView.findViewById(R.id.listView_forecast);
31        listView.setAdapter(mForecastAdapter);
32        return rootView;
33    }
34
35
36
37
38
39
40
41
42
43
44 }
```

Turn Array Adapter should be public to be amendable

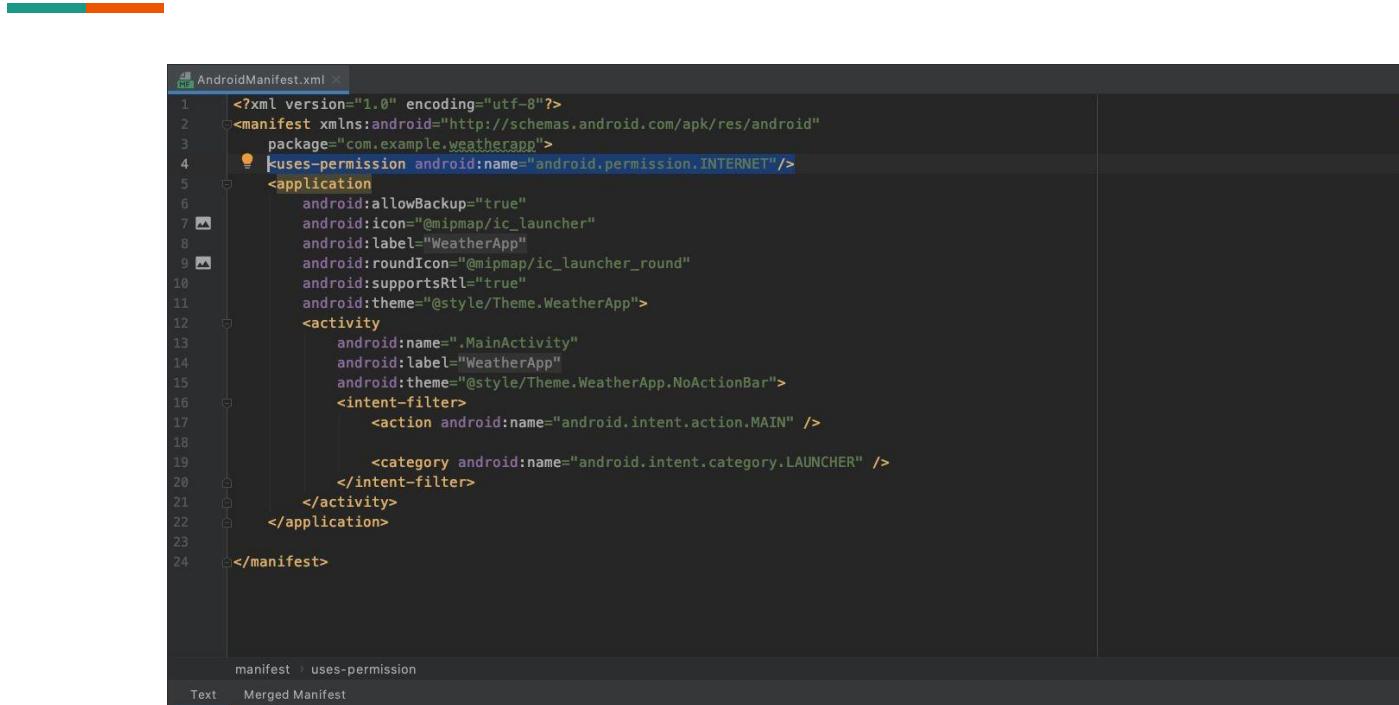


Add menu option (Update Forecast)



```
SecondFragment.java
1 package com.example.weatherapp;
2
3 import ...
4
5 public class SecondFragment extends Fragment {
6
7     @Override
8     public View onCreateView(
9             LayoutInflater inflater, ViewGroup container,
10            Bundle savedInstanceState
11    ){{...}}
12
13    @Override
14    public void onCreateOptionsMenu(Menu menu, MenuInflater inflater) {
15        inflater.inflate(R.menu.forecast_update, menu);
16    }
17
18    @Override
19    public boolean onOptionsItemSelected(MenuItem item) {
20        // Handle action bar item clicks here. The action bar will
21        // automatically handle clicks on the Home/Up button, so long
22        // as you specify a parent activity in AndroidManifest.xml.
23        int id = item.getItemId();
24        if (id == R.id.action_refresh) {
25            // Call Weather API - Update Forecast Adapter
26            return true;
27        }
28        return super.onOptionsItemSelected(item);
29    }
30
31
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67
68
69 }
```

Update business logic to support new menu

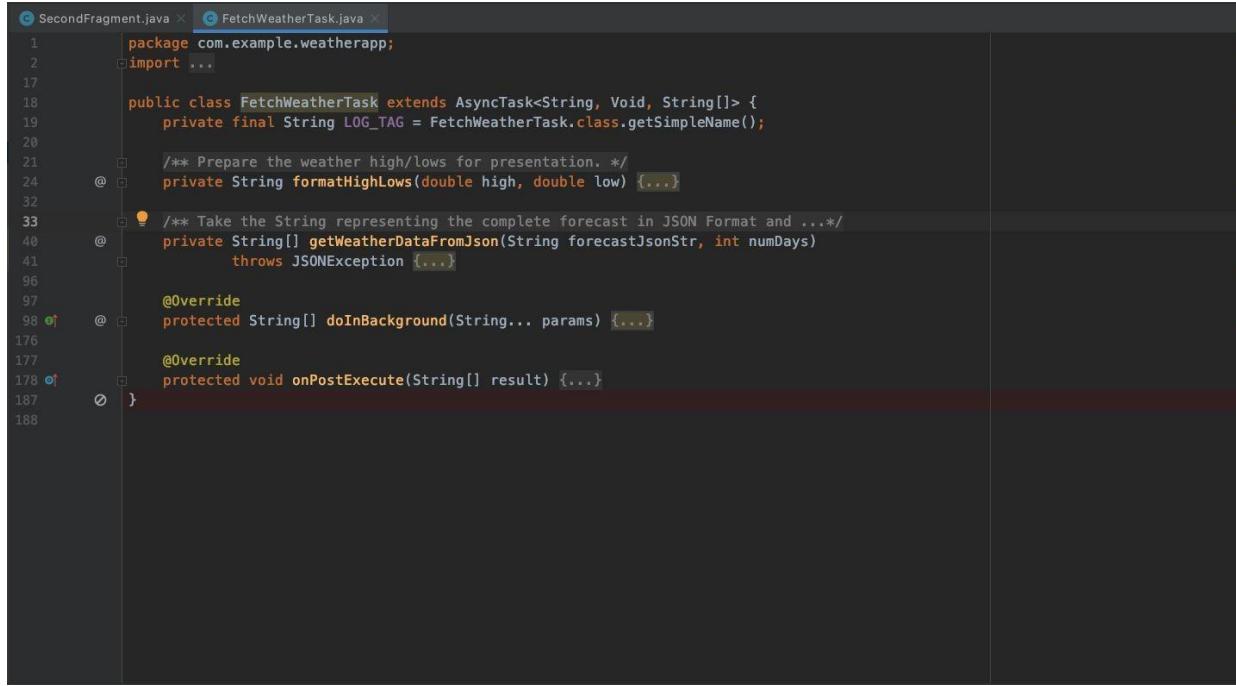


The screenshot shows the AndroidManifest.xml file in an IDE. The manifest includes a uses-permission tag for the INTERNET permission. The code is as follows:

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.weatherapp">
    <uses-permission android:name="android.permission.INTERNET"/>
    <application
        android:allowBackup="true"
        android:icon="@mipmap/ic_launcher"
        android:label="WeatherApp"
        android:roundIcon="@mipmap/ic_launcher_round"
        android:supportsRtl="true"
        android:theme="@style/Theme.WeatherApp">
        <activity
            android:name=".MainActivity"
            android:label="WeatherApp"
            android:theme="@style/Theme.WeatherApp.NoActionBar">
            <intent-filter>
                <action android:name="android.intent.action.MAIN" />
                <category android:name="android.intent.category.LAUNCHER" />
            </intent-filter>
        </activity>
    </application>
</manifest>
```

The manifest node is expanded, showing the uses-permission node. The bottom navigation bar indicates the current view is "Text".

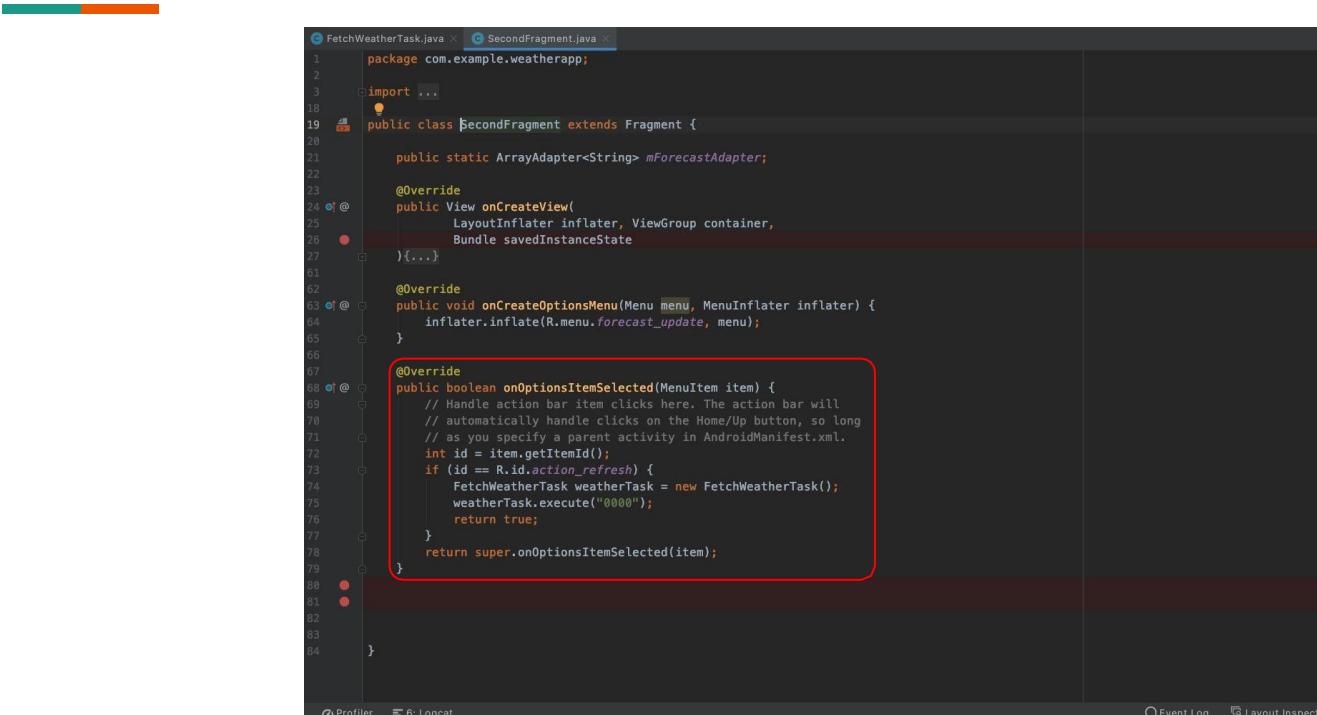
Add permission for internet in
manifest



The screenshot shows a code editor with two tabs: "SecondFragment.java" and "FetchWeatherTask.java". The "FetchWeatherTask.java" tab is active, displaying the following Java code:

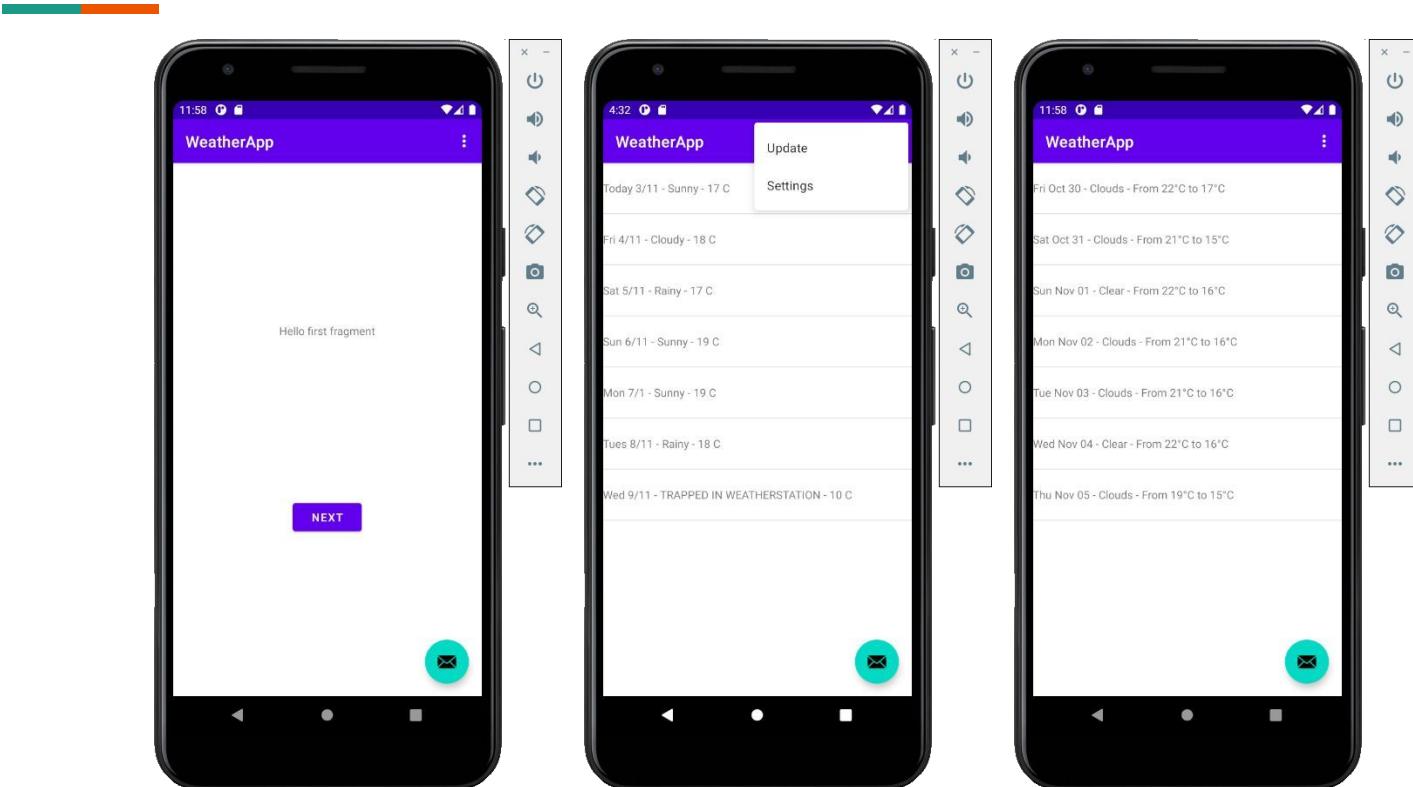
```
1 package com.example.weatherapp;
2 import ...
17
18 public class FetchWeatherTask extends AsyncTask<String, Void, String[]> {
19     private final String LOG_TAG = FetchWeatherTask.class.getSimpleName();
20
21     /** Prepare the weather high/lows for presentation. */
22     @Override
23     private String formatHighLows(double high, double low) {...}
24
25     /** Take the String representing the complete forecast in JSON Format and ...*/
26     @Override
27     private String[] getWeatherDataFromJson(String forecastJsonStr, int numDays)
28         throws JSONException {...}
29
30     @Override
31     protected String[] doInBackground(String... params) {...}
32
33     @Override
34     protected void onPostExecute(String[] result) {...}
35 }
```

Build business logic to fetch and preview
forecast

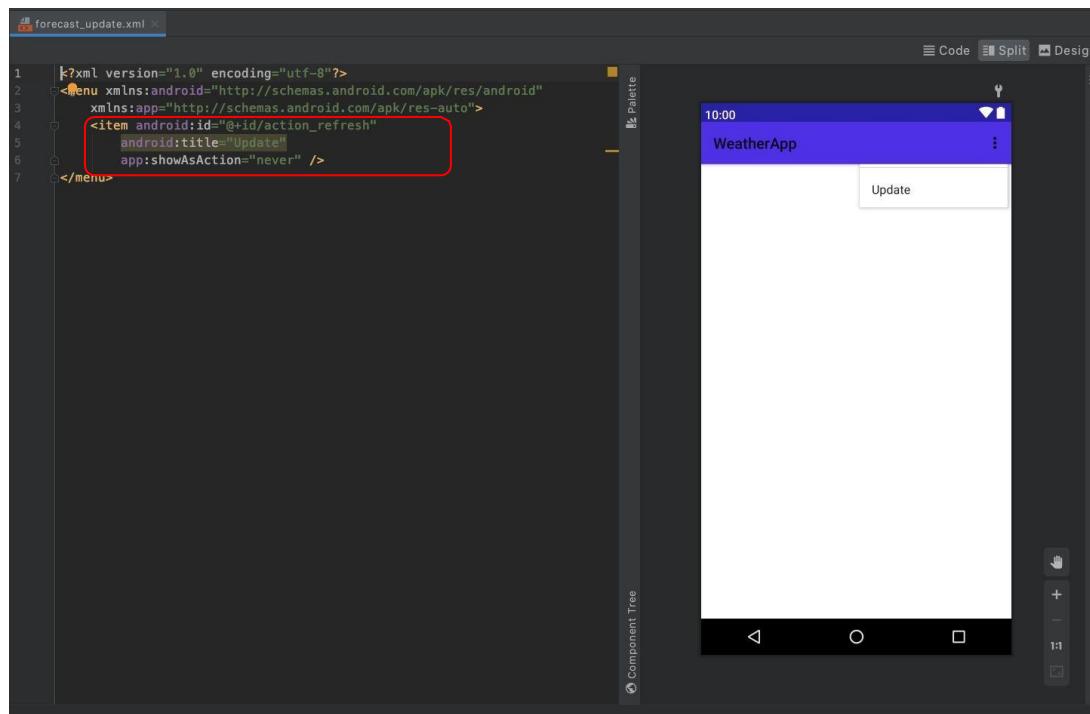


```
1 package com.example.weatherapp;
2
3 import ...
4
5 public class SecondFragment extends Fragment {
6
7     public static ArrayAdapter<String> mForecastAdapter;
8
9     @Override
10    public View onCreateView(
11        LayoutInflater inflater, ViewGroup container,
12        Bundle savedInstanceState
13    ) {...}
14
15    @Override
16    public void onCreateOptionsMenu(Menu menu, MenuInflater inflater) {
17        inflater.inflate(R.menu.forecast_update, menu);
18    }
19
20    @Override
21    public boolean onOptionsItemSelected(MenuItem item) {
22        // Handle action bar item clicks here. The action bar will
23        // automatically handle clicks on the Home/Up button, so long
24        // as you specify a parent activity in AndroidManifest.xml.
25        int id = item.getItemId();
26        if (id == R.id.action_refresh) {
27            FetchWeatherTask weatherTask = new FetchWeatherTask();
28            weatherTask.execute("0000");
29            return true;
30        }
31        return super.onOptionsItemSelected(item);
32    }
33
34 }
```

Build business logic to fetch and preview forecast



Add Voice Recognition Functionality



```
1 <?xml version="1.0" encoding="utf-8"?>
2 <menu xmlns:android="http://schemas.android.com/apk/res/android"
3     xmlns:app="http://schemas.android.com/apk/res-auto">
4     <item android:id="@+id/action_refresh"
5         android:title="Update"
6         app:showAsAction="never" />
7 </menu>
```

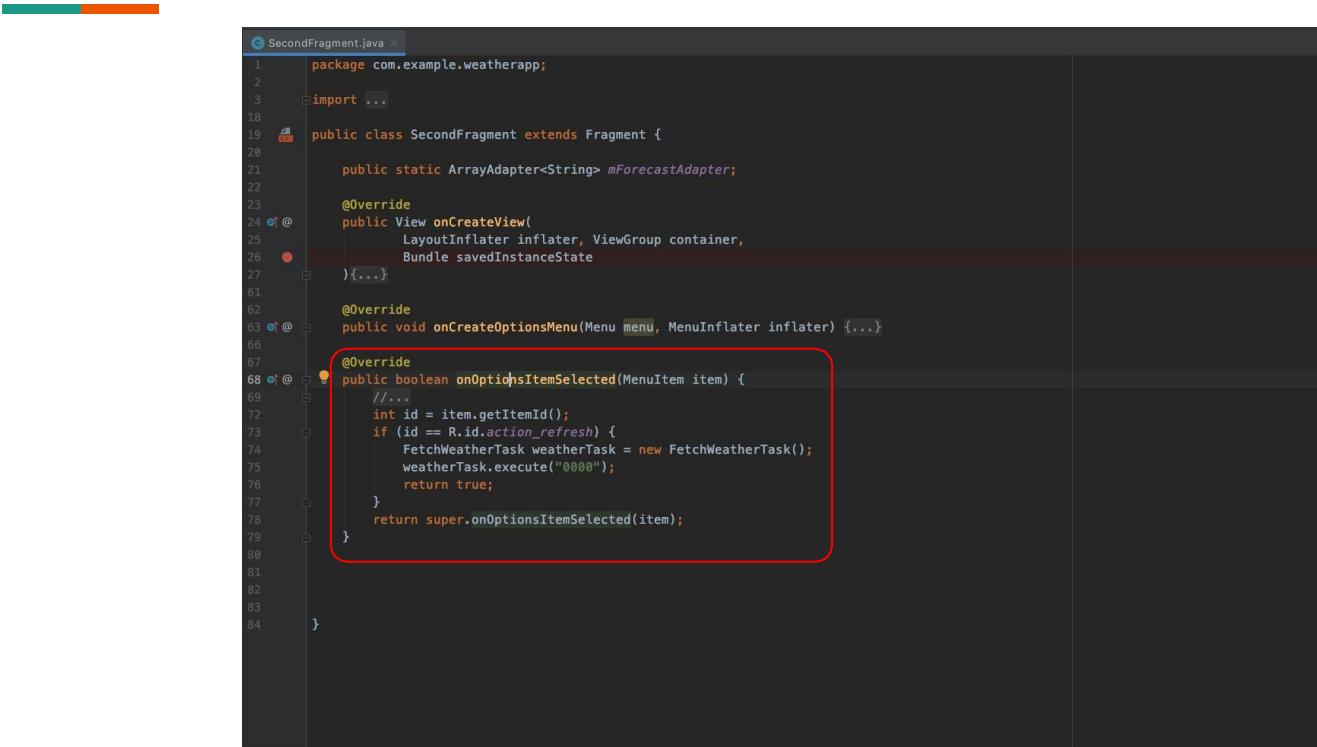
We need a new option in the menu to initiate speech recognition

The screenshot shows the Android Studio interface with the `forecast_update.xml` file open in the code editor. The XML code defines a menu with two items: "Update" and "Ask me!". The "Ask me!" item is highlighted with a red box. To the right, the preview window shows a smartphone screen titled "WeatherApp" with the same two menu items.

```
<?xml version="1.0" encoding="utf-8"?>
<menu xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:app="http://schemas.android.com/apk/res-auto">
    <item android:id="@+id/action_refresh"
        android:title="Update"
        app:showAsAction="never" />
    <item android:id="@+id/voice_commands"
        android:title="Ask me!"
        app:showAsAction="never" />
</menu>
```

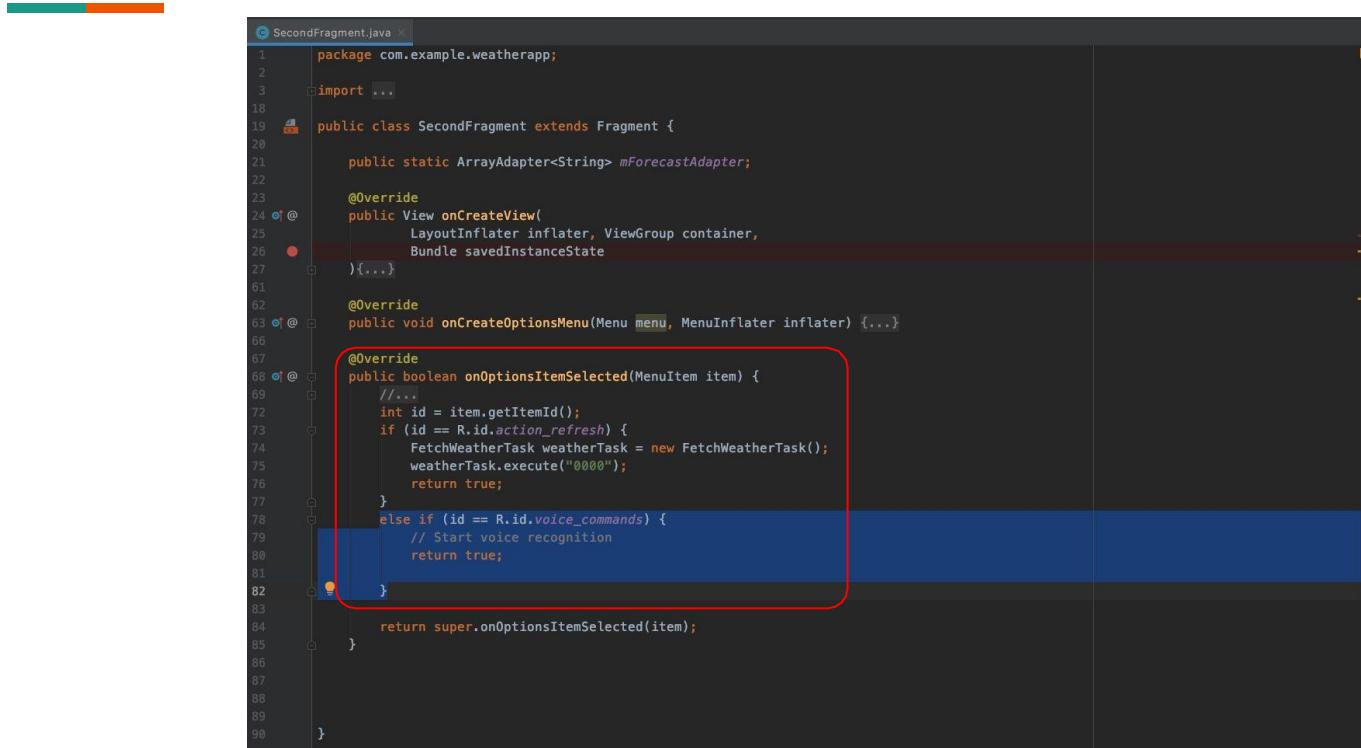
Add new option "Ask
me!"

```
<?xml version="1.0" encoding="utf-8"?>
<menu
    xmlns:android="http://schemas.android.com/apk/res/android"
    >
    <item android:id="@+id/action_refresh"
        android:title="Refresh"
        app:showAsAction="never" />
    <item android:id="@+id/voice_commands"
        android:title="Ask me!" />
</menu>
```



```
SecondFragment.java
1 package com.example.weatherapp;
2 import ...
18
19 public class SecondFragment extends Fragment {
20
21     public static ArrayAdapter<String> mForecastAdapter;
22
23     @Override
24     @Override
25     public View onCreateView(
26         LayoutInflater inflater, ViewGroup container,
27         Bundle savedInstanceState
28     ) {...}
29
30     @Override
31     public void onCreateOptionsMenu(Menu menu, MenuInflater inflater) {...}
32
33     @Override
34     public boolean onOptionsItemSelected(MenuItem item) {
35         //...
36         int id = item.getItemId();
37         if (id == R.id.action_refresh) {
38             FetchWeatherTask weatherTask = new FetchWeatherTask();
39             weatherTask.execute("0000");
40             return true;
41         }
42         return super.onOptionsItemSelected(item);
43     }
44 }
```

We also need to support this option in our code



```
SecondFragment.java
1 package com.example.weatherapp;
2
3 import ...
18
19 public class SecondFragment extends Fragment {
20
21     public static ArrayAdapter<String> mForecastAdapter;
22
23     @Override
24     public View onCreateView(
25         LayoutInflater inflater, ViewGroup container,
26         Bundle savedInstanceState
27     ) {...}
28
29     @Override
30     public void onCreateOptionsMenu(Menu menu, MenuInflater inflater) {...}
31
32     @Override
33     public boolean onOptionsItemSelected(MenuItem item) {
34         //...
35         int id = item.getItemId();
36         if (id == R.id.action_refresh) {
37             FetchWeatherTask weatherTask = new FetchWeatherTask();
38             weatherTask.execute("0000");
39             return true;
40         }
41         else if (id == R.id.voice_commands) {
42             // Start voice recognition
43             return true;
44         }
45     }
46
47     return super.onOptionsItemSelected(item);
48 }
49
50 }
```

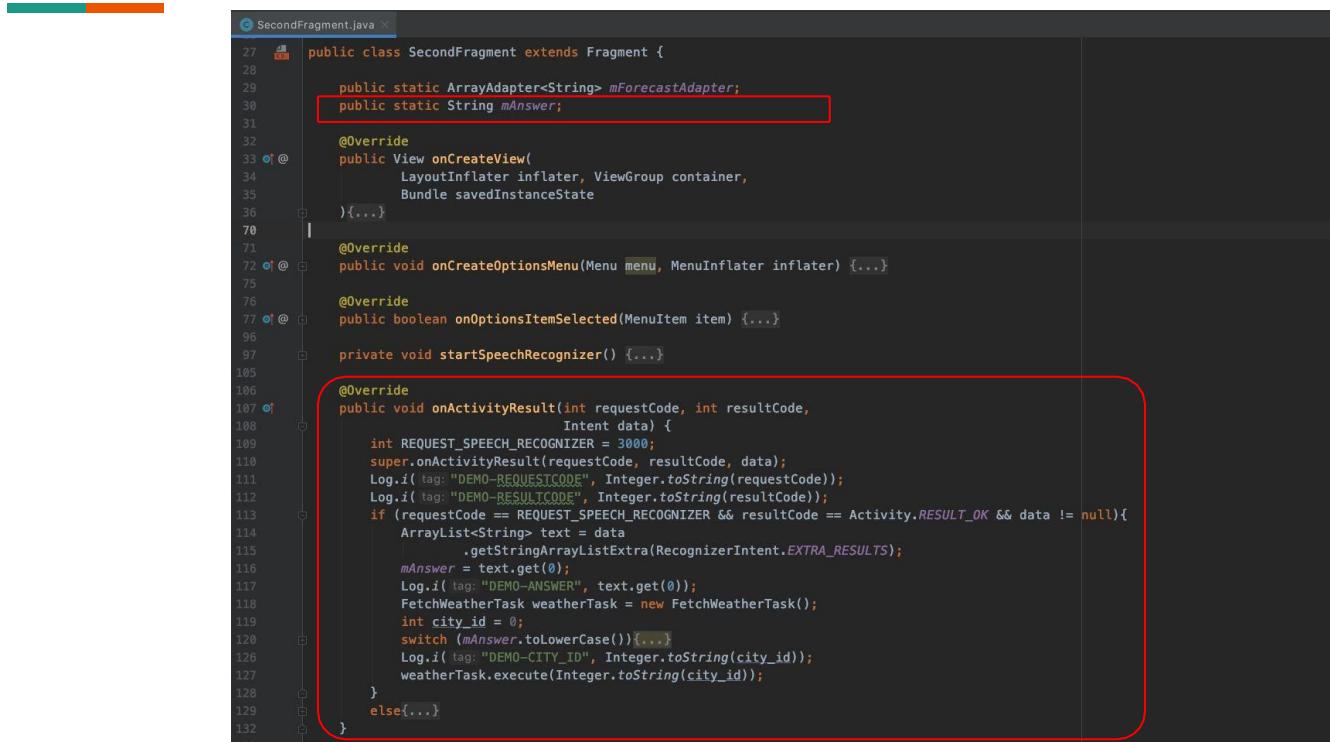
We also need to support this option in our code

```
24 public class SecondFragment extends Fragment {  
25  
26     public static ArrayAdapter<String> mForecastAdapter;  
27  
28     @Override  
29     public View onCreateView(  
30             LayoutInflater inflater, ViewGroup container,  
31             Bundle savedInstanceState  
32     ) {...}  
33  
34     @Override  
35     public void onCreateOptionsMenu(Menu menu, MenuInflater inflater) {...}  
36  
37     @Override  
38     public boolean onOptionsItemSelected(MenuItem item) {  
39         //...  
40         int id = item.getItemId();  
41         if (id == R.id.action_refresh) {  
42             FetchWeatherTask weatherTask = new FetchWeatherTask();  
43             weatherTask.execute("000");  
44             return true;  
45         }  
46         else if (id == R.id.voice_commands) {  
47             // Start voice recognition  
48             startSpeechRecognizer();  
49             return true;  
50         }  
51         return super.onOptionsItemSelected(item);  
52     }  
53  
54     private void startSpeechRecognizer() {  
55         int REQUEST_SPEECH_RECOGNIZER = 3000;  
56         Intent intent = new Intent  
57             (RecognizerIntent.ACTION_RECOGNIZE_SPEECH);  
58         intent.putExtra(RecognizerIntent.EXTRA_LANGUAGE_MODEL, value: "en-US");  
59         intent.putExtra(RecognizerIntent.EXTRA_PROMPT, value: "City of Interest?");  
60         startActivityForResult(intent, REQUEST_SPEECH_RECOGNIZER);  
61     }  
62 }
```

Add new function to initiate speech recognition using API

```
    @Override
    public boolean onMenuItemSelected(@NonNull MenuItem item) {
        // Handle menu item clicks
        if (item.getItemId() == R.id.action_refresh) {
            FetchWeatherForecast weatherTask = new FetchWeatherForecast();
            double city_lat =38.04;
            double city_long=23.54;
            weatherTask.executeOnExecutor(AsyncTask.THREAD_POOL_EXECUTOR, Double.toString(city_lat),
                Double.toString(city_long));
            return true; // Indicate that the event was handled
        }
        else if (item.getItemId() == R.id.voice_commands) {
            // Start voice recognition
            startSpeechRecognizer();
            return true;
        }
        return false; // Let the system handle other menu actions
    }
}, getViewLifecycleOwner(), Lifecycle.State.RESUMED); // Ensure the menu is only active when the fragment is visible
```

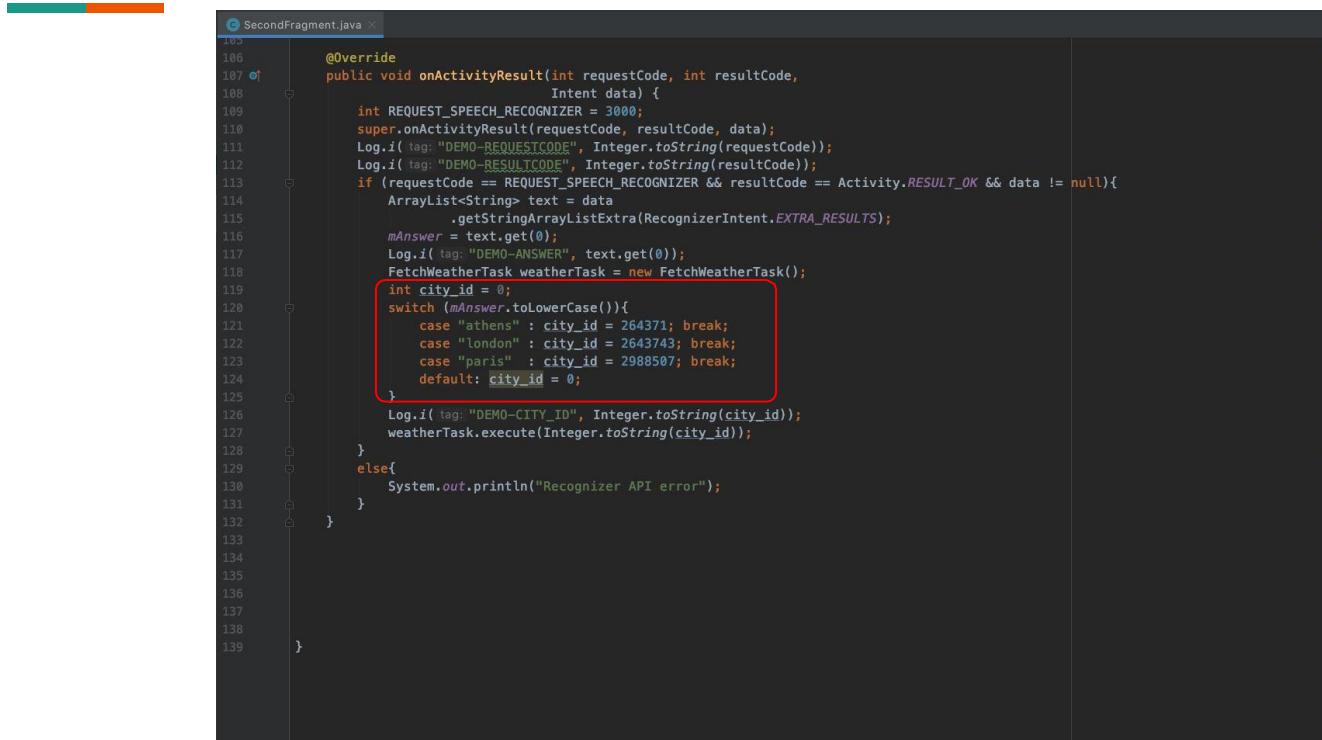
```
private void startSpeechRecognizer() {  
    int REQUEST_SPEECH_RECOGNIZER = 3000;  
    Intent intent = new Intent  
        (RecognizerIntent.ACTION_RECOGNIZE_SPEECH);  
    intent.putExtra(RecognizerIntent.EXTRA_LANGUAGE_MODEL, "en-US");  
    intent.putExtra(RecognizerIntent.EXTRA_PROMPT,"City of Interest?");  
    startActivityForResult(intent, REQUEST_SPEECH_RECOGNIZER);  
}
```



```
SecondFragment.java
```

```
27     public class SecondFragment extends Fragment {
28
29         public static ArrayAdapter<String> mForecastAdapter;
30         public static String mAnswer;
31
32         @Override
33         public View onCreateView(
34             LayoutInflater inflater, ViewGroup container,
35             Bundle savedInstanceState
36         ) {...}
37
38         @Override
39         public void onCreateOptionsMenu(Menu menu, MenuInflater inflater) {...}
40
41         @Override
42         public boolean onOptionsItemSelected(MenuItem item) {...}
43
44         private void startSpeechRecognizer() {...}
45
46         @Override
47         public void onActivityResult(int requestCode, int resultCode,
48             Intent data) {
49             int REQUEST_SPEECH_RECOGNIZER = 3000;
50             super.onActivityResult(requestCode, resultCode, data);
51             Log.i( tag: "DEMO-REQUESTCODE", Integer.toString(requestCode));
52             Log.i( tag: "DEMO-RESULTCODE", Integer.toString(resultCode));
53             if (requestCode == REQUEST_SPEECH_RECOGNIZER && resultCode == Activity.RESULT_OK && data != null){
54                 ArrayList<String> text = data
55                     .getStringArrayListExtra(RecognizerIntent.EXTRA_RESULTS);
56                 mAnswer = text.get(0);
57                 Log.i( tag: "DEMO-ANSWER", text.get(0));
58                 FetchWeatherTask weatherTask = new FetchWeatherTask();
59                 int city_id = 0;
60                 switch (mAnswer.toLowerCase()){...}
61                 Log.i( tag: "DEMO-CITY_ID", Integer.toString(city_id));
62                 weatherTask.execute(Integer.toString(city_id));
63             }
64             else{...}
65         }
66     }
```

Handle transcription of speech



```
SecondFragment.java ×
105
106     @Override
107     public void onActivityResult(int requestCode, int resultCode,
108             Intent data) {
109         int REQUEST_SPEECH_RECOGNIZER = 3000;
110         super.onActivityResult(requestCode, resultCode, data);
111         Log.i( tag: "DEMO-REQUESTCODE", Integer.toString(requestCode));
112         Log.i( tag: "DEMO-RESULTCODE", Integer.toString(resultCode));
113         if (requestCode == REQUEST_SPEECH_RECOGNIZER && resultCode == Activity.RESULT_OK && data != null){
114             ArrayList<String> text = data
115                 .getStringArrayListExtra(RecognizerIntent.EXTRA_RESULTS);
116             mAnswer = text.get(0);
117             Log.i( tag: "DEMO-ANSWER", text.get(0));
118             FetchWeatherTask weatherTask = new FetchWeatherTask();
119             int city_id = 0;
120             switch (mAnswer.toLowerCase()){
121                 case "athens" : city_id = 264371; break;
122                 case "london" : city_id = 264374; break;
123                 case "paris" : city_id = 2988507; break;
124                 default: city_id = 0;
125             }
126             Log.i( tag: "DEMO-CITY_ID", Integer.toString(city_id));
127             weatherTask.execute(Integer.toString(city_id));
128         } else{
129             System.out.println("Recognizer API error");
130         }
131     }
132 }
133
134
135
136
137
138
139 }
```

Naive control for voice commands (Support 3 cities)

```
@Override
public void onActivityResult(int requestCode, int resultCode,
    Intent data) {
    int REQUEST_SPEECH_RECOGNIZER = 3000;
    super.onActivityResult(requestCode, resultCode, data); Log.i("DEMO-REQUESTCODE",
    Integer.toString(requestCode)); Log.i("DEMO-RESULTCODE", Integer.toString(resultCode));
    if (requestCode == REQUEST_SPEECH_RECOGNIZER && resultCode == Activity.RESULT_OK && data != null){
        ArrayList<String> text = data
            .getStringArrayListExtra(RecognizerIntent.EXTRA_RESULTS);
        mAnswer = text.get(0);
        Log.i("DEMO-ANSWER", text.get(0));
        FetchWeatherForecast weatherTask = new FetchWeatherForecast();
        double city_lat = 0;
        double city_long = 0;
        switch (mAnswer.toLowerCase()){
            case "athens" : city_lat = 37.98; city_long = 23.73; break;
            case "elefsina" : city_lat = 38.04; city_long = 23.54; break;
            case "london" : city_lat = 51.51; city_long = 0.13; break;
            case "paris" : city_lat = 48.86; city_long = 2.35; break;
            case "αθήνα" : city_lat = 37.98; city_long = 23.73; break;
            case "ελευσίνα" : city_lat = 38.04; city_long = 23.54; break;
            case "λονδίνο" : city_lat = 51.51; city_long = 0.13; break;
            case "παρίσι" : city_lat = 48.86; city_long = 2.35; break;
            default : city_lat = 38.04; city_long = 23.54;
        }
        Log.i("LAT", Double.toString(city_lat));
        Log.i("LONG", Double.toString(city_long));
        weatherTask.executeOnExecutor(AsyncTask.THREAD_POOL_EXECUTOR,
        Double.toString(city_lat), Double.toString(city_long));
    }
    else{
        System.out.println("Recognizer API error");
    }
}
```



```
import android.content.Intent;
import android.speech.RecognizerIntent;
import android.app.Activity;
import android.util.Log;

public static String mAnswer,
```

```
@Override
protected String[] doInBackground(String... params) {
    // These two need to be declared outside the try/catch
    // so that they can be closed in the finally block.
    HttpURLConnection urlConnection = null;
    BufferedReader reader = null;

    if (params.length == 0) {
        return null;
    }

    int numDays = 7;

    // Will contain the raw JSON response as a string.
    String forecastJsonStr = null;

    try {
        // Construct the URL for the OpenWeatherMap query
        // Possible parameters are available at OWM's forecast API page, at
        // http://openweathermap.org/API#forecast
        //String baseUrl = "https://api.openweathermap.org/data/2.5/forecast?lat=38.04&lon=23.54&units=metric&cnt=7";
        String baseUrl = "https://api.openweathermap.org/data/2.5/onecall?units=metric&exclude=minutely,current,alerts,hourly";
        baseUrl = baseUrl+"&lat="+params[0)+"&lon="+params[1];
```

Use input params in FetchWeatherForecast Task

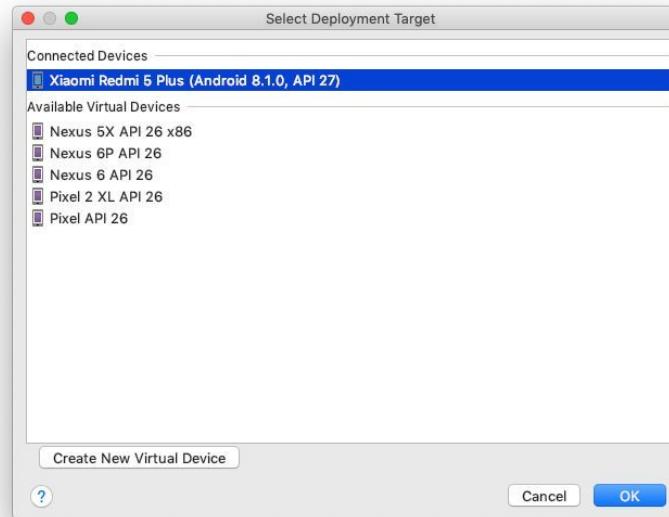
```
String baseUrl =  
"https://api.openweathermap.org/data/2.5/forecast/daily?&units=metric&exclude=minute  
ly,current,alerts,hourly";  
baseUrl = baseUrl+"&lat="+params[0)+"&lon="+params[1];
```

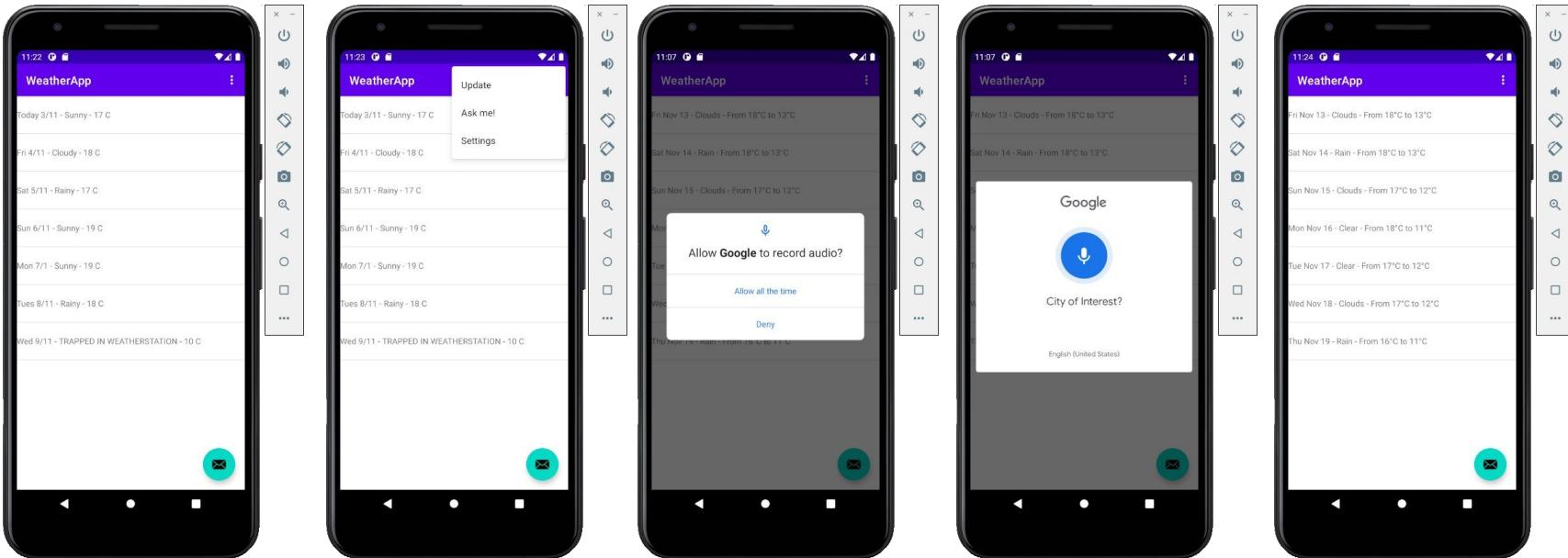
Deploy Application on real device

██████████



Unlock debug mode





```
2020-11-13 11:09:19.277 2378-2378/com.example.weatherapp I/DEMO-REQUESTCODE: 3000
2020-11-13 11:09:19.277 2378-2378/com.example.weatherapp I/DEMO-RESULTCODE: -1
2020-11-13 11:09:19.299 2378-2378/com.example.weatherapp I/DEMO-ANSWER: Temple
2020-11-13 11:09:19.300 2378-2378/com.example.weatherapp I/DEMO-CITY_ID: 0
2020-11-13 11:09:19.948 2378-3206/com.example.weatherapp W/Results: [Ljava.lang.String;@f812210
2020-11-13 11:09:59.367 2378-2378/com.example.weatherapp I/DEMO-REQUESTCODE: 3000
2020-11-13 11:09:59.367 2378-2378/com.example.weatherapp I/DEMO-RESULTCODE: -1
2020-11-13 11:09:59.367 2378-2378/com.example.weatherapp I/DEMO-ANSWER: Waterloo
2020-11-13 11:09:59.367 2378-2378/com.example.weatherapp I/DEMO-CITY_ID: 0
2020-11-13 11:09:59.922 2378-3206/com.example.weatherapp W/Results: [Ljava.lang.String;@dd5417a
2020-11-13 11:11:04.091 2378-2378/com.example.weatherapp I/DEMO-REQUESTCODE: 3000
2020-11-13 11:11:04.091 2378-2378/com.example.weatherapp I/DEMO-RESULTCODE: -1
2020-11-13 11:11:04.091 2378-2378/com.example.weatherapp I/DEMO-ANSWER: Wonder
2020-11-13 11:11:04.091 2378-2378/com.example.weatherapp I/DEMO-CITY_ID: 0
2020-11-13 11:11:04.683 2378-3206/com.example.weatherapp W/Results: [Ljava.lang.String;@f74ea94
```

Logging of interaction through voice commands

Review of Lab 3 - Android Application Development

- Catch up with Lab 1-2
- Add Voice Recognition functionality
 - Rename Activity
 - Make property publicly available
 - Update Business Logic to use the Asynchronous task - Involve "Ask me!" Option
 - Demonstrate updates

Ασκήσεις μελέτης B2



Άσκηση B2.2

- α) Χρησιμοποιώντας τις παρακάτω προτάσεις ως (μικροσκοπικό) σώμα κειμένων εκπαίδευσης:
- <start> he plays football
 - <start> he plays cricket
 - <start> she enjoys good football
 - <start> she plays good music
 - <start> he prays to god
 - <start> please buy me the other ball
 - <start> he pleases the other players by playing good football

εκτιμήστε τις πιθανότητες $P(t_1^4)$ που θα επέστρεψε ένα γλωσσικό μοντέλο **διγραμμάτων** με **εξομάλυνση Laplace** για κάθε μία από τις δύο παρακάτω προτάσεις

t_1^4 :<start> he please god football
 t_1^4 : <start> he plays good football

Υποθέστε ότι το λεξιλόγιο V περιέχει όλες τις λέξεις του σώματος κειμένων (εξαιρώντας το <start>), οπότε $|V| = 21$. Δείξτε λεπτομερώς τους υπολογισμούς σας, χωρίς να εκτελέσετε τις τελικές αριθμητικές πράξεις.



- $P(<\text{start}>, \text{he}, \text{please}, \text{god}, \text{football}) = P(\text{he} | <\text{start}>) P(\text{please} | \text{he}) P(\text{god} | \text{please}) P(\text{football} | \text{god})$
 $P(\text{he} | <\text{start}>) = (4+1)/(7+21)$
 $P(\text{please} | \text{he}) = (0+1)/(4+21)$
 $P(\text{god} | \text{please}) = (0+1)/(1+21)$
 $P(\text{football} | \text{god}) = (0+1)/(1+21)$
- $P(<\text{start}>, \text{he}, \text{plays}, \text{good}, \text{football}) = P(\text{he} | <\text{start}>) P(\text{plays} | \text{he}) P(\text{good} | \text{plays}) P(\text{football} | \text{good})$
 $P(\text{he} | <\text{start}>) = (4+1)/(7+21)$
 $P(\text{plays} | \text{he}) = (2+1)/(4+21)$
 $P(\text{good} | \text{plays}) = (1+1)/(3+21)$
 $P(\text{football} | \text{good}) = (2+1)/(3+21)$

Σημείωση: Στην πράξη αποφεύγουμε διαδοχικούς πολλαπλασιασμούς πιθανοτήτων, υπολογίζουμε συνήθως τον λογάριθμο της πιθανότητας μιας ακολουθίας λέξεων, δηλαδή θα υπολογίζαμε το $\log P(<\text{start}>, \text{he}, \text{please}, \text{god}, \text{football})$, αντί του $P(<\text{start}>, \text{he}, \text{please}, \text{god}, \text{football})$, οπότε θα καταλήγαμε στο παρακάτω άθροισμα τεσσάρων λογαρίθμων, αντί του παραπάνω γινομένου τεσσάρων πιθανοτήτων:
 $\log[(4+1)/(7+21)] + \log[(0+1)/(4+21)] + \log[(0+1)/(1+21)] + \log[(0+1)/(1+21)]$

?

- β) Υποθέστε ότι ένας χρήστης έγραψε στο πληκτρολόγιο του κινητού του την παρακάτω ακολουθία λέξεων

w_1^4 : <start> he pls gd ftball

Εκτιμήστε τις πιθανότητες $P(t_1^4 | w_1^4)$ των δύο υποθέσεων (ακολουθιών λέξεων που ίσως ήθελε να γράψει) t_1^4 του σκέλους (α), χρησιμοποιώντας ένα μοντέλο θορυβώδους καναλιού (βλ. σχετικές διαφάνειες) και το γλωσσικό μοντέλο διγραμμάτων του σκέλους (α).

t_1^4 :<start> he please god football
 t_1^4 :<start> he plays good football

$$\hat{t}_1^k = \arg \max_{t_1^k} P(t_1^k | w_1^k) = \arg \max_{t_1^k} \frac{P(t_1^k) \cdot P(w_1^k | t_1^k)}{P(w_1^k)}$$

$$P(w_1^k | t_1^k) \approx \prod_{i=1}^k P(w_i | t_i)$$

Θεωρήστε ότι $P(w_i | t_i) \cong 1/(LD(w_i, t_i) + 1)$, όπου $LD(w_i, t_i)$ η απόσταση Levenshtein από τη λέξη w_i στην t_i . Δείξτε λεπτομερώς τους υπολογισμούς σας, χωρίς να εκτελέσετε τις τελικές αριθμητικές πράξεις και χωρίς να υπολογίσετε τις αποστάσεις Levenshtein.



Χρησιμοποιώντας το θορυβώδες κανάλι των διαφανειών της διάλεξης, έχουμε:

$$P(t_1^4 | w_1^4) = P(t_1^4) P(w_1^4 | t_1^4) / P(w_1^4)$$

Για $t_1^4 = \langle \text{start} \rangle$ he please god football:

$$P(t_1^4) = P(\langle \text{start} \rangle, \text{he}, \text{please}, \text{god}, \text{football})$$

$$P(w_1^4 | t_1^4) / P(w_1^4) = P(\langle \text{start} \rangle \text{ he pls gd ftball} | \langle \text{start} \rangle, \text{he}, \text{please}, \text{god}, \text{football}) / P(w_1^4)$$

Η πιθανότητα $P(\langle \text{start} \rangle, \text{he}, \text{please}, \text{god}, \text{football})$ εκτιμάται από το γλωσσικό μοντέλο, όπως στο σκέλος (α).

Χρησιμοποιώντας την προσέγγιση $P(w_i | t_i) \approx 1/(LD(w_i, t_i)+1)$ της εκφώνησης (βλ. και διαφάνειες), η πιθανότητα $P(w_1^4 | t_1^4) = P(\langle \text{start} \rangle \text{ he pls gd ftball} | \langle \text{start} \rangle, \text{he}, \text{please}, \text{god}, \text{football})$ γίνεται:

$$P(\text{he}, \text{he}) P(\text{pls}, \text{please}) P(\text{gd}, \text{god}) P(\text{ftball}, \text{football}) =$$

$$1/(LD(\text{he}, \text{he})+1) 1/(LD(\text{pls}, \text{please})+1) 1/(LD(\text{gd}, \text{god})+1) 1/(LD(\text{ftball}, \text{football})+1)$$

Η πιθανότητα $P(w_1^4)$ δεν χρειάζεται να εκτιμηθεί, γιατί είναι ίδια και για τις δύο υποθέσεις $t_1^4 = \langle \text{start} \rangle$ he please god football και $t_1^4 = \langle \text{start} \rangle$ he plays good football.



Ομοίως εκτιμούμε την πιθανότητα $P(t_1^4 | w_1^4)$ για την υπόθεση $t_1^4 = \text{<start>}$ he plays good football.
Επιλέγουμε τελικά την υπόθεση t_1^4 με το μεγαλύτερο $P(t_1^4 | w_1^4)$.

Σημείωση: Και πάλι στην πράξη θα υπολογίζαμε τον λογάριθμο κάθε γινομένου πιθανοτήτων, οπότε θα καταλήγαμε σε αθροίσματα λογαρίθμων πιθανοτήτων, αντί γινόμενα πιθανοτήτων.

?

γ)

Εξηγήστε αναλυτικά πώς θα γινόταν η αποκωδικοποίηση με beam search (διαφάνειες «Beam search decoder»), αν ο χρήστης γράψει στο πληκτρολόγιο την ακολουθία λέξεων w_1^4 του σκέλους (β).

w_1^4 : <start> he pls gd ftball

Χρησιμοποιούμε πάλι το γλωσσικό μοντέλο διγραμμάτων λέξεων του σκέλους (α), εκπαιδευμένο στο μικροσκοπικό σώμα εκπαίδευσης εκείνου του σκέλους,

<start> he plays football

<start> he plays cricket

<start> she enjoys good football

<start> she plays good music

<start> he prays to god

<start> please buy me the other ball

<start> he pleases the other players by playing good football

μαζί με το μοντέλο θορυβώδους καναλιού του σκέλους (β).

Θεωρήστε ότι το **πλέγμα (lattice)** αναζήτησης είναι το ακόλουθο, δηλαδή περιλαμβάνει **4 κοντινές** (κατά απόσταση διόρθωσης) υποψήφιες σωστές λέξεις (του λεξικού), για κάθε λέξη w_i που έχει γράψει ο χρήστης. Σε κάθε βήμα του beam search, κρατάμε τα $b = 2$ καλύτερα μονοπάτια.



$k = 0$

$k = 1$
 $w_1 = \text{he}$

$k = 2$
 $w_2 = \text{pls}$

$k = 3$
 $w_3 = \text{gd}$

$k = 4$
 $w_4 = \text{ftball}$



—

$$P(t_1^1) P(w_1^1 | t_1^1)$$



$k = 0$

$k = 1$
 $w_1 = \text{he}$

$k = 2$
 $w_2 = \text{pls}$

$k = 3$
 $w_3 = \text{gd}$

$k = 4$
 $w_4 = \text{ftball}$



Για k= 1

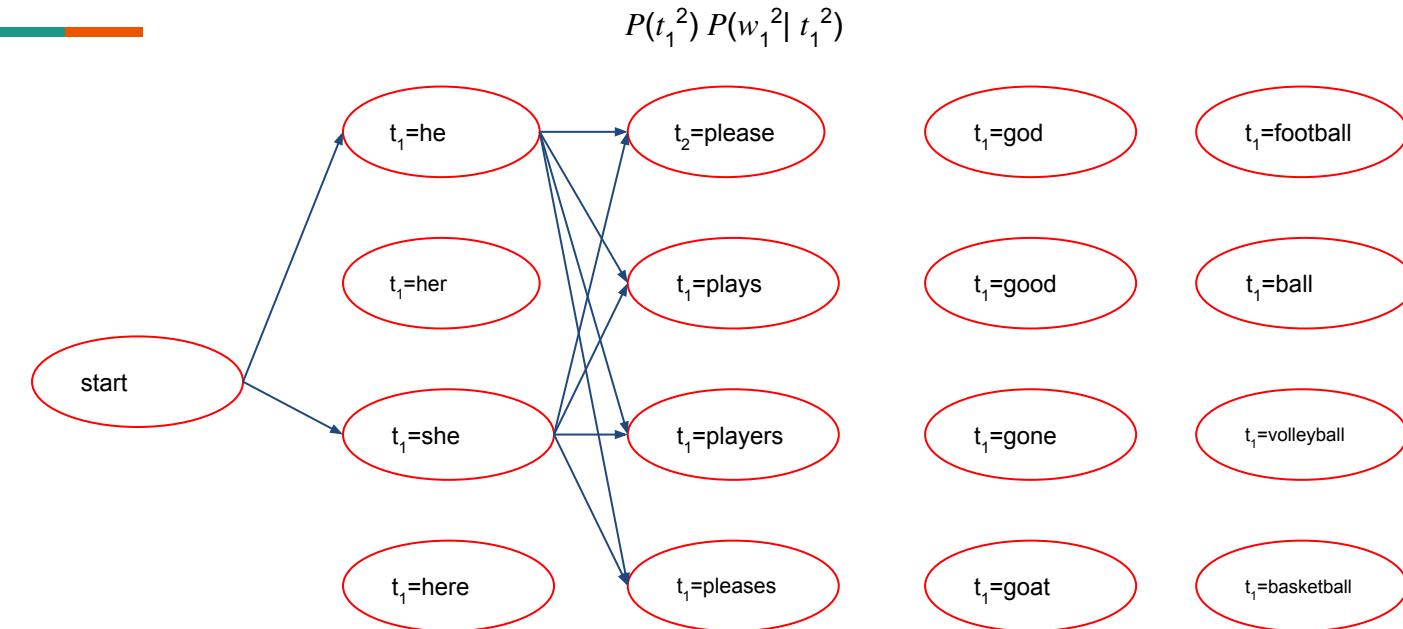
<start, he>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) = (4+1)/(7+21) 1/(0+1) = 5/28 = \mathbf{0.179} **$

<start, her>: $P(\text{her}|\text{start}) P(\text{he}|\text{her}) = (0+1)/(7+21) 1/(1+1) = 1/28 1/2 = 0.018$

<start, she>: $P(\text{she}|\text{start}) P(\text{he}|\text{she}) = (2+1)/(7+21) 1/(1+1) = 3/28 1/2 = \mathbf{0.054} **$

<start, here>: $P(\text{here}|\text{start}) P(\text{he}|\text{here}) = (0+1)/(7+21) 1/(2+1) = 1/28 1/3 = 0.012$

<start> he plays football
<start> he plays cricket
<start> she enjoys good football
<start> she plays good music
<start> he prays to god
<start> please buy me the other ball
<start> he pleases the other players by playing good football



$k = 0$

$k = 1$
 $w_1 = \text{he}$

$k = 2$
 $w_2 = \text{pls}$

$k = 3$
 $w_3 = \text{gd}$

$k = 4$
 $w_4 = \text{ftball}$



Probability

Για k= 2

<start, he, please>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{please}|\text{he}) P(\text{pls}|\text{please}) = 5/28 (0+1)/(4+21) 1/(3+1) = 0.0018$

<start, he, plays>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{plays}|\text{he}) P(\text{pls}|\text{plays}) = 5/28 (2+1)/(4+21) 1/(1+2) = \mathbf{0.0071} **$

<start, he, players>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{players}|\text{he}) P(\text{pls}|\text{players}) = 5/28 (0+1)/(4+21) 1/(4+1) = 0.0014$

<start, he, pleases>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{pleases}|\text{he}) P(\text{pls}|\text{pleases}) = 5/28 (1+1)/(4+21) 1/(4+1) = \mathbf{0.0029} **$

<start, she, please>: $P(\text{she}|\text{start}) P(\text{he}|\text{she}) P(\text{please}|\text{she}) P(\text{pls}|\text{please}) = 3/56 (0+1)/(2+21) 1/(3+1) = 0.0006$

<start, she, plays>: $P(\text{she}|\text{start}) P(\text{he}|\text{she}) P(\text{plays}|\text{she}) P(\text{pls}|\text{plays}) = 3/56 (1+1)/(2+21) 1/(2+1) = 0.0016$

<start, she, players>: $P(\text{she}|\text{start}) P(\text{he}|\text{she}) P(\text{players}|\text{she}) P(\text{pls}|\text{players}) = 3/56 (0+1)/(2+21) 1/(4+1) = 0.0005$

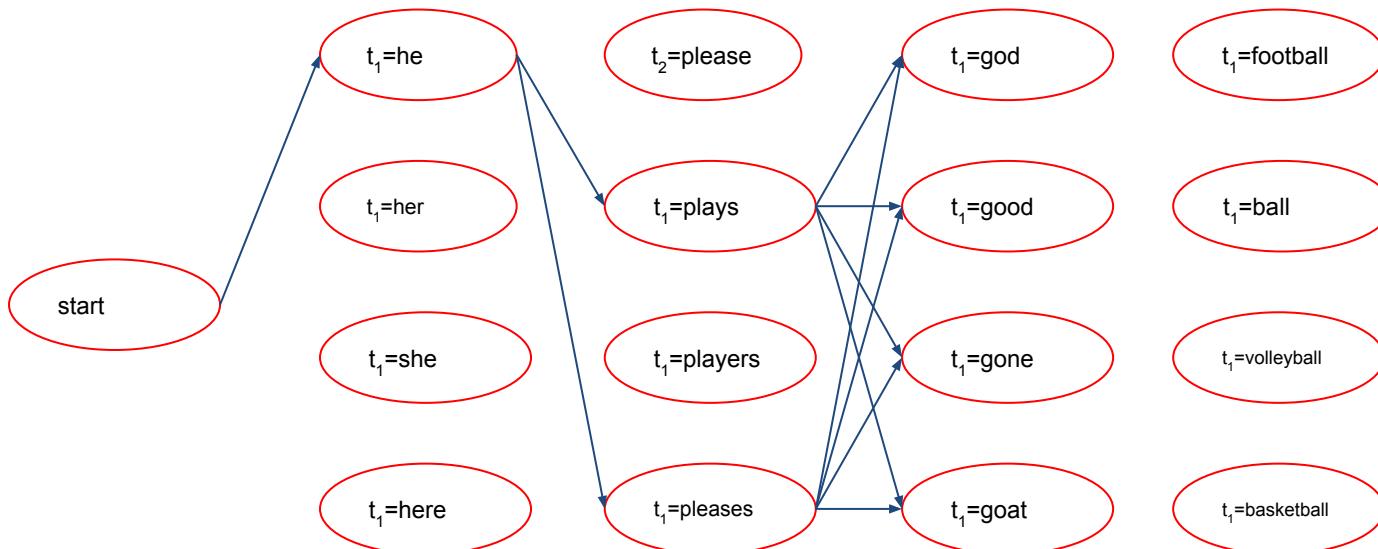
<start, she, pleases>: $P(\text{she}|\text{start}) P(\text{he}|\text{she}) P(\text{pleases}|\text{she}) P(\text{pls}|\text{pleases}) = 3/56 (0+1)/(2+21) 1/(4+1) = 0.0005$

<start> he plays football
<start> he plays cricket
<start> she enjoys good football
<start> she plays good music
<start> he prays to god
<start> please buy me the other ball
<start> he pleases the other players by playing good football



—

$$P(t_1^3) P(w_1^3 | t_1^3)$$



$k = 0$

$k = 1$

$w_1 = \text{he}$

$k = 2$

$w_2 = \text{pls}$

$k = 3$

$w_3 = \text{gd}$

$k = 4$

$w_4 = \text{ftball}$



Για $k=3$

<start, he, plays, god>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{plays}|\text{he}) P(\text{pls}|\text{plays}) P(\text{god}|\text{plays}) P(\text{gd}|\text{god}) = 0.0071 \frac{(0+1)}{(3+21)} \frac{1}{(1+1)} = 0.00015$ **

<start, he, plays, good>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{plays}|\text{he}) P(\text{pls}|\text{plays}) P(\text{good}|\text{plays}) P(\text{gd}|\text{good}) = 0.0071 \frac{(1+1)}{(3+21)} \frac{1}{(2+1)} = 0.0002$ **

<start, he, plays, gone>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{plays}|\text{he}) P(\text{pls}|\text{plays}) P(\text{gone}|\text{plays}) P(\text{gd}|\text{gone}) = 0.0071 \frac{(0+1)}{(3+21)} \frac{1}{(4+1)} = 0.00006$

<start, he, plays, goat>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{plays}|\text{he}) P(\text{pls}|\text{plays}) P(\text{goat}|\text{plays}) P(\text{gd}|\text{goat}) = 0.0071 \frac{(0+1)}{(3+21)} \frac{1}{(4+1)} = 0.00006$

<start, he, pleases, god>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{pleases}|\text{he}) P(\text{pls}|\text{pleases}) P(\text{god}|\text{pleases}) P(\text{gd}|\text{god}) = 0.0029 \frac{(0+1)}{(1+21)} \frac{1}{(1+1)} = 0.00007$

<start, he, pleases, good>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{pleases}|\text{he}) P(\text{pls}|\text{pleases}) P(\text{good}|\text{pleases}) P(\text{gd}|\text{good}) = 0.0029 \frac{(0+1)}{(1+21)} \frac{1}{(2+1)} = 0.00004$

<start, he, pleases, gone>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{pleases}|\text{he}) P(\text{pls}|\text{pleases}) P(\text{gone}|\text{pleases}) P(\text{gd}|\text{gone}) = 0.0029 \frac{(0+1)}{(1+21)} \frac{1}{(4+1)} = 0.00003$

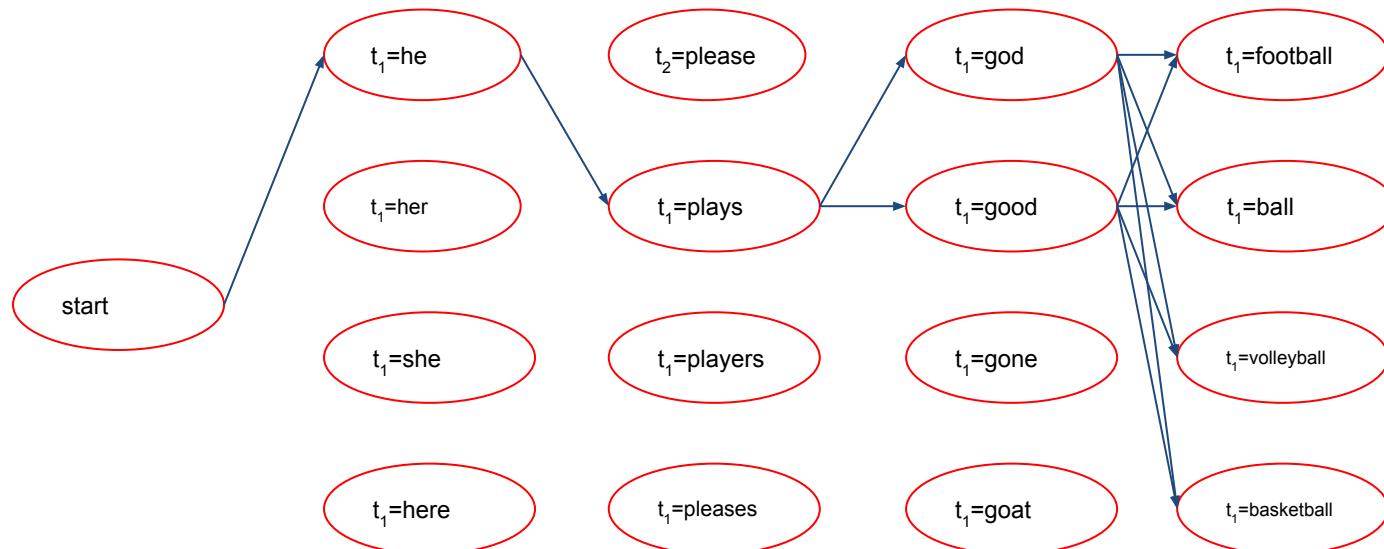
<start, he, pleases, goat>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{pleases}|\text{he}) P(\text{pls}|\text{pleases}) P(\text{goat}|\text{pleases}) P(\text{gd}|\text{goat}) = 0.0029 \frac{(0+1)}{(1+21)} \frac{1}{(4+1)} = 0.00003$

<start> he plays football
<start> he plays cricket
<start> she enjoys good football
<start> she plays good music
<start> he prays to god
<start> please buy me the other ball
<start> he pleases the other players by playing good football



—

$$P(t_1^4) P(w_1^4 | t_1^4)$$



$k = 0$

$k = 1$

$w_1 = \text{he}$

$k = 2$

$w_2 = \text{pls}$

$k = 3$

$w_3 = \text{gd}$

$k = 4$

$w_4 = \text{ftball}$



Για $k=3$

<start> he plays football
<start> he plays cricket
<start> she enjoys good football
<start> she plays good music
<start> he prays to god
<start> please buy me the other ball
<start> he pleases the other players by playing good football

<start, he, plays, god, football>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{plays}|\text{he}) P(\text{pls}|\text{plays}) P(\text{god}|\text{plays}) P(\text{gd}|\text{god}) P(\text{football}|\text{god}) P(\text{ftball}|\text{football}) = 0.00015 (0+1)/(1+21) 1/(2+1) = 0.0000023$

<start, he, plays, god, ball>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{plays}|\text{he}) P(\text{pls}|\text{plays}) P(\text{god}|\text{plays}) P(\text{gd}|\text{god}) P(\text{ball}|\text{god}) P(\text{ftball}|\text{ball}) = 0.00015 (0+1)/(1+21) 1/(2+1) = 0.0000023$

<start, he, plays, god, volleyball>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{plays}|\text{he}) P(\text{pls}|\text{plays}) P(\text{god}|\text{plays}) P(\text{gd}|\text{god}) P(\text{volleyball}|\text{god}) P(\text{ftball}|\text{volleyball}) = 0.00015 (0+1)/(1+21) 1/(8+1) = 0.00000076$

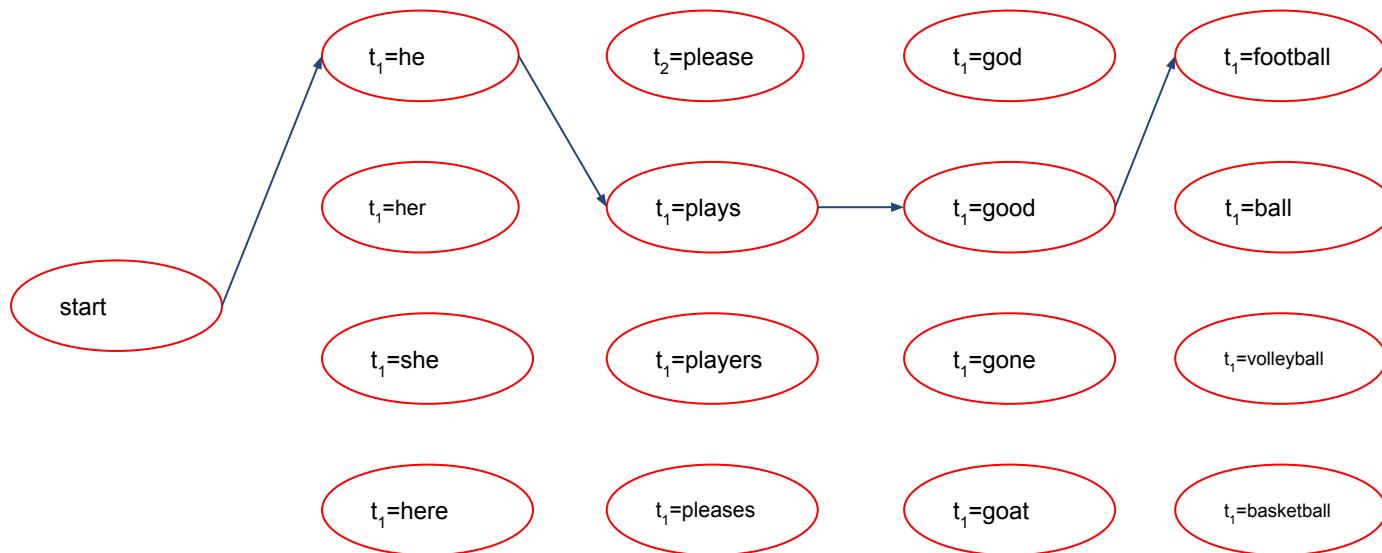
<start, he, plays, god, basketball>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{plays}|\text{he}) P(\text{pls}|\text{plays}) P(\text{god}|\text{plays}) P(\text{gd}|\text{god}) P(\text{basketball}|\text{god}) P(\text{ftball}|\text{basketball}) = 0.00015 (0+1)/(1+21) 1/(6+1) = 0.00000097$

<start, he, plays, good, football>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{plays}|\text{he}) P(\text{pls}|\text{plays}) P(\text{good}|\text{plays}) P(\text{gd}|\text{good}) P(\text{football}|\text{good}) P(\text{ftball}|\text{football}) = 0.0002 (2+1)/(3+21) 1/(2+1) = \mathbf{0.0000083}^{**}$

<start, he, plays, good, ball>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{plays}|\text{he}) P(\text{pls}|\text{plays}) P(\text{good}|\text{plays}) P(\text{gd}|\text{good}) P(\text{ball}|\text{good}) P(\text{ftball}|\text{ball}) = 0.0002 (0+1)/(3+21) 1/(2+1) = 0.0000028$

<start, he, plays, good, volleyball>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{plays}|\text{he}) P(\text{pls}|\text{plays}) P(\text{good}|\text{plays}) P(\text{gd}|\text{good}) P(\text{volleyball}|\text{good}) P(\text{ftball}|\text{volleyball}) = 0.0002 (0+1)/(3+21) 1/(8+1) = 0.00000093$

<start, he, plays, good, basketball>: $P(\text{he}|\text{start}) P(\text{he}|\text{he}) P(\text{plays}|\text{he}) P(\text{pls}|\text{plays}) P(\text{good}|\text{plays}) P(\text{gd}|\text{good}) P(\text{basketball}|\text{good}) P(\text{ftball}|\text{basketball}) = 0.0002 (0+1)/(3+21) 1/(6+1) = 0.0000012$



$k = 0$

$k = 1$

$w_1 = \text{he}$

$k = 2$

$w_2 = \text{pls}$

$k = 3$

$w_3 = \text{gd}$

$k = 4$

$w_4 = \text{ftball}$