ANDROID GPS

Peter Larsson-Green

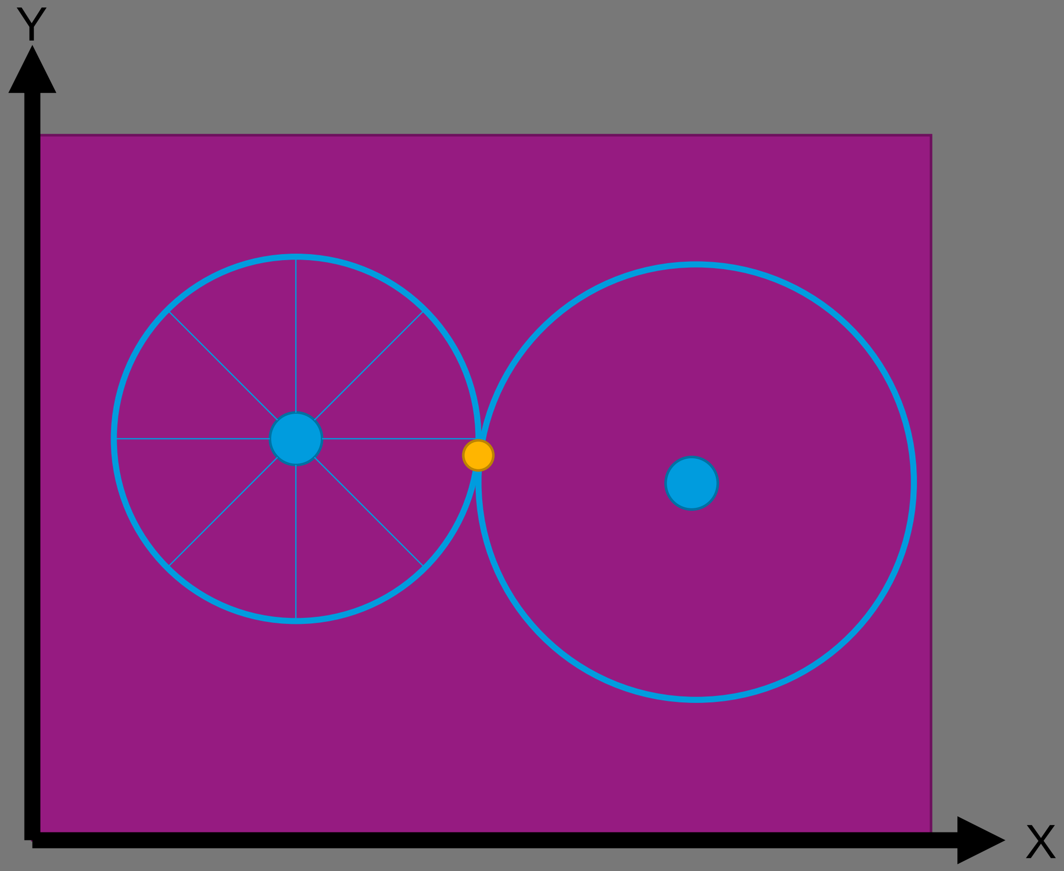
Jönköping University

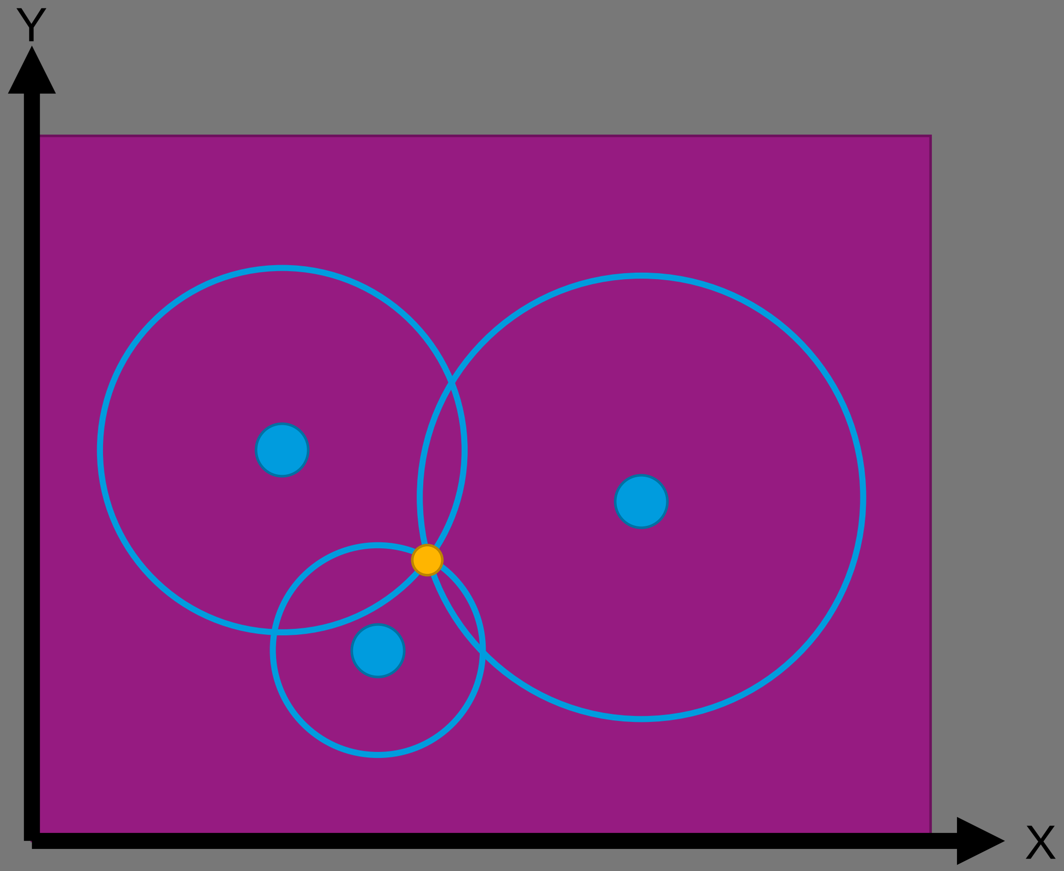
Spring 2020

GLOBAL POSITIONING SYSTEM

- Not only GPS, could be GLONASS (Soviet/Russia), completed 2011.
- Upcoming: Galileo (European Union), BeiDou-2 (China).
- Relies on trilateration:
  - More connected satellites → better precision.
  - Each connected satellite consumes battery power.

TRILATERATION (2D) IN THEORY

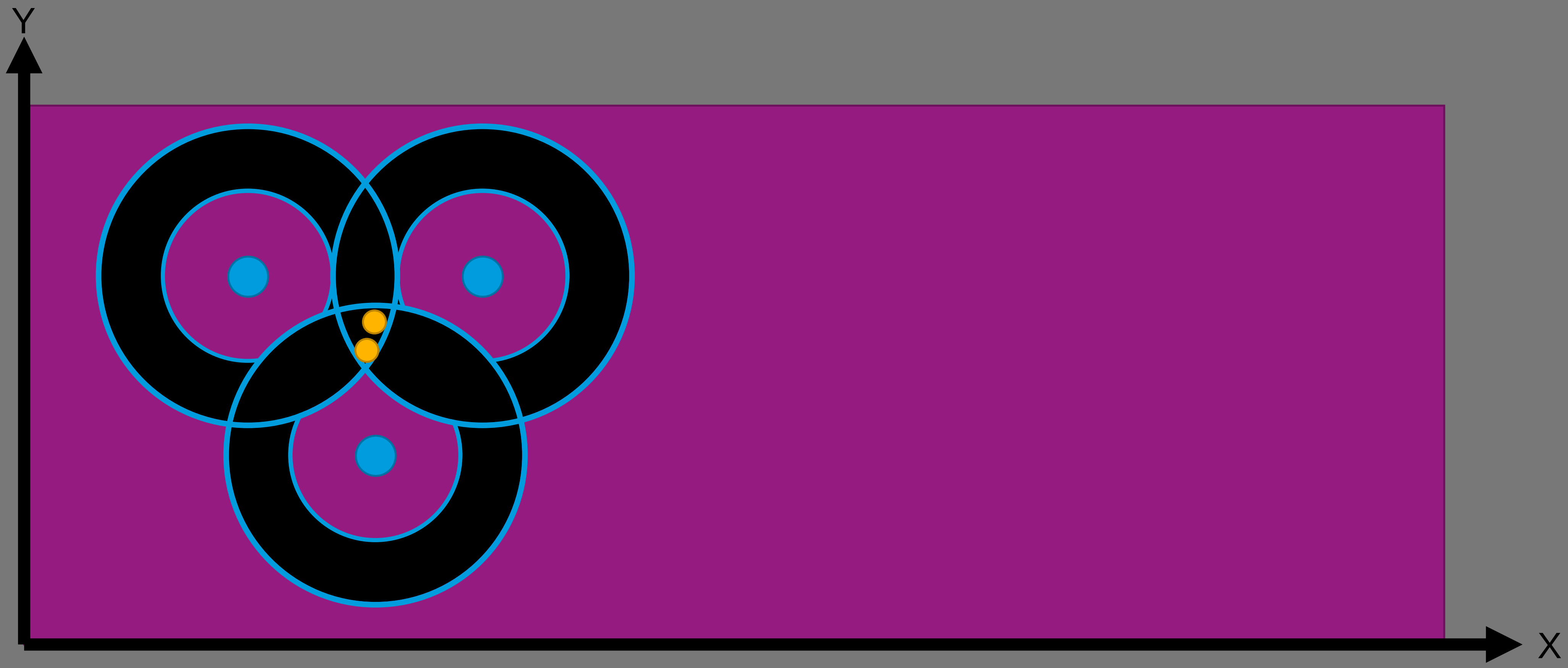




TRILATERATION (3D)

- Distance to each reference point yields a sphere.
- Overlapping spheres yields the border of a circle.
  - 4 reference points needed!

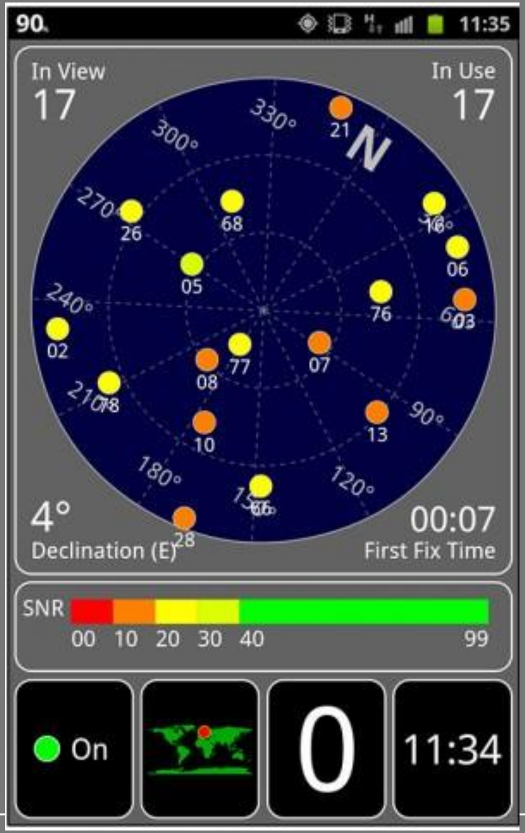
TRILATERATION (2D) IN PRACTICE



TESTING GPS

Use the app GPS test from the Play Store.

- https://play.google.com/store/apps/details?id=com.chartcross.gpstest



- Number 1-32 are GPS.
- Number 65-96 are GLONASS.

FINDING CURRENT LOCATION

- `LocationManager` has a set of `LocationProviders`.
- Are protected by dangerous permissions.
  - `ACCESS_COARSE_LOCATION`
  - `ACCESS_FINE_LOCATION`

LOCATION - NETWORK

- Cell tower trilateration (signal strength).
- Public WiFi hotspots.

LOCATION PROVIDERS

```
LocationManager locationManager = (LocationManager)
        aContext.getSystemService(Context.LOCATION_SERVICE);
List<String> availableProviders =
                                locationManager.getAllProviders();
for(String provider : availableProviders){
   Log.d("Available Providers", "Provider name: "+provider);
}
```

```
Provider name: passive
Provider name: gps
Provider name: network
```

LOCATION PROVIDERS

```
ACCURACY_LOW     > 500 meter
ACCURACY_MEDIUM  < 500 meter
ACCURACY_HIGH    < 100 meter
```

```
Criteria criteria = new Criteria();
criteria.setAltitudeRequired(true);
criteria.setAccuracy(Criteria.ACCURACY_HIGH);
String name = locationManager.getBestProvider(criteria, false);
boolean isEnabled = locationManager.isProviderEnabled(name);
Location location = locationManager.getLastKnownLocation(name);
double altitude = location.getAltitude();
double latitude = location.getLatitude();
double longitude = location.getLongitude();
float accuracy = location.getAccuracy();
```

Enabled only?

68% chance within a circle with this radius [meters].

CREATING LOCATION LISTENERS

```
LocationListener locationListener = new LocationListener(){
  @Override
  public void onLocationChanged(Location location){ }
  @Override
  public void onStatusChanged(String provider, int status,
                              Bundle extras){ }
  @Override
  public void onProviderEnabled(String provider){ }
  @Override
  public void onProviderDisabled(String provider){ }
};
```

```
OUT_OF_SERVICE
TEMPORARILY_UNAVAILABLE
AVAILABLE
```

USING LOCATION LISTENERS

```
locationManager.requestLocationUpdates(
  LocationManager.GPS_PROVIDER, 0, 0, locationListener
);
locationManager.requestLocationUpdates(
  LocationManager.NETWORK_PROVIDER, 0, 0, locationListener
);
```

minTime
[milliseconds]

minDistance
[meters]

```
locationManager.removeUpdates(locationListener);
```

GOOGLE PLAY SERVICES

Services provided by Google.

- Not all devices got this (Google Play Store → Google Play Services).
- Includes:
  - Android Pay (Google Wallet).
  - Google Account Login.
  - Google Cast (control Android TV & Chromecast devices).
  - Google Cloud Messaging.
  - Google Maps.
  - Google Mobile Ads
  - Google Location Services (the fused location provider).
- Usage in Android Studio: https://developers.google.com/android/guides/setup

Emulators must run Android 4.2.2 or higher with a Google API image.

THE FUSED LOCATION PROVIDER

- In Android SDK manager: install Google Repository.

```
dependencies {
  [...]
  compile 'com.google.android.gms:play-services-location:8.3.0'
}
```

```
<uses-permission android:name="android.permission.ACCESS_FINE_LOCATION"/>
```

```
<uses-permission android:name="android.permission.ACCESS_COARSE_LOCATION"/>
```

GETTING READY

```
GoogleApiClient.Builder clientBuilder =
                       new GoogleApiClient.Builder(aContext);
clientBuilder.addApi(LocationServices.API);
clientBuilder.addConnectionCallbacks(
  new GoogleApiClient.ConnectionCallbacks(){
    @Override
    public void onConnected(Bundle bundle){ }
    @Override
    public void onConnectionSuspended(int cause){ }
  }
);
```

GETTING READY

```
clientBuilder.addOnConnectionFailedListener(
  new GoogleApiClient.OnConnectionFailedListener(){
    @Override
    public void onConnectionFailed(
                          ConnectionResult connectionResult){
    }
  }
);
GoogleApiClient playServices = clientBuilder.build();
playServices.connect();
```

GETTING THE LOCATION

```
Location loc = LocationServices.
              FusedLocationApi.getLastLocation(playServices);
```

```
playServices.disconnect();
```

USING LOCATION LISTENERS

```
LocationRequest locationRequest = new LocationRequest();
locationRequest.setInterval(1000);
locationRequest.setNumUpdates(10);
locationRequest.setExpirationDuration(10000);
locationRequest.setPriority(
   LocationRequest.PRIORITY_HIGH_ACCURACY
);
```

USING LOCATION LISTENERS

```
LocationSettingsRequest.Builder builder =
                       new LocationSettingsRequest.Builder();
builder.addLocationRequest(locationRequest);
LocationSettingsRequest locationSettingsRequest =
                                             builder.build();
```

USING LOCATION LISTENERS

```
PendingResult<LocationSettingsResult> result =

          LocationServices.SettingsApi.checkLocationSettings(
            playServices, locationSettingsRequest
          );

result.setResultCallback(

  new ResultCallback<LocationSettingsResult>(){

    @Override

    public void onResult(LocationSettingsResult result){

      // Check result.getStatus().getStatusCode().

    }

  }

);
```

USING LOCATION LISTENERS

```
public void onResult(LocationSettingsResult result){
  switch(result.getStatus().getStatusCode()){
    case LocationSettingsStatusCodes.SUCCESS:
      // The request can be handled :D
    break;
    case LocationSettingsStatusCodes.RESOLUTION_REQUIRED:
      // The user needs to activate more accurate providers.
    break;
    default:
      // We're screwed :'(
  }
}
```

USING LOCATION LISTENERS

```
switch(result.getStatus().getStatusCode()){
  case LocationSettingsStatusCodes.SUCCESS:
    LocationServices.FusedLocationApi.
      requestLocationUpdates(
        playServices,
        locationRequest,
        new LocationListener(){
          @Override
          public void onLocationChanged(Location location){ }
        }
      );
}
```

USES FEATURES

- Hides your app from devices lacking necessary features on the Play Store.

```
<manifest ...>
  <uses-feature android:name="android.hardware.location" />
  <uses-feature android:name="android.hardware.location.gps" />
  <uses-feature android:name="android.hardware.camera" />
  <uses-feature android:name="android.hardware.wifi" />
  <uses-feature android:name="android.hardware.telephony" />
</manifest>
```

http://developer.android.com/guide/topics/manifest/uses-feature-element.html#hw-features

USES FEATURES

- Some `<uses-permissions>` implies `<uses-feature>`.
- Use uses-feature to change that.

```
<manifest ...>
   <uses-permission
      android:name="android.permission.ACCESS_FINE_LOCATION" />
   <uses-feature android:required="false"
      android:name="android.hardware.location" />
   <uses-feature android:required="false"
      android:name="android.hardware.location.gps" />
</manifest>
```