At which North Pole does Santa Claus live?
True North

The earth’s axis of rotation
Magnetic North
Where your compass points
Grid North

Where the UTM grid lines “point” to
The North Reference you choose determines where 0° is when you measure an angle with your protractor or compass.
True v.s. Magnetic North
What is the difference here?

- Fruitvale Ave. is aligned with True North.
- So are the edges of parking lots 4 & 5.
- Let’s go take a bearing along the edge of lot 4 and see what we get…
USA Declination Map

East Declination

True North

Magnetic North

Magnetic North is >True North

West Declination

True North

Magnetic North

Magnetic North is <True North
US/UK World Magnetic Chart -- Epoch 2000
Declination - Main Field (D)

Units (Declination) : degrees
Contour Interval : 2 degrees
Map Projection : Mercator
High Definition Geomagnetic Model
Declination Diagrams
Declination changes over time

• Here in Northern California it changes by about 1° every 20 years.
• The declination shown on your topo map may be out of date.
• What about declination displayed by my GPS?
  – It probably correct as of the date of manufacture.
Magnetic Poles

North Pole

South Pole
Declination Calculator at www.ngdc.noaa.gov
Local Anomalies

• May be as much as 90 degrees
  –3-4 degrees is common

• North of Kingston, Ontario; 90° of anomalous declination.
• Kingston Harbor, Ontario; 16.3° W to 15.5° E of anomalous declination over two kilometers (1.2 miles); magnetite and ilmenite deposits.
• Savoff, Ontario (50.0 N, 85.0 W). Over 60° of anomalous declination.
• Ramapo Mountains, northeastern New Jersey; iron ore; compass rendered useless in some areas.
• Near Grants, New Mexico north of the Gila Wilderness area; Malpais lava flows; compass rendered useless.
Using your GPS & compass to measure current local magnetic declination

\[ d > 300 \text{m} \]

**GPS**
- GOTO WPT001
- Bearing 214° True

**Compass**
- Bearing to Palm
  - 200° Magnetic

Current Local Magnetic Declination is 14° East of True North
Angular Error in GPS Bearing to Waypoint

\[ \tan(\alpha) = \frac{5}{d} = \frac{10}{2d} \]

\[ \alpha = \tan^{-1}\left(\frac{10}{d}\right) \]

<table>
<thead>
<tr>
<th>(d)</th>
<th>(\alpha)</th>
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<tbody>
<tr>
<td>100m</td>
<td>6°</td>
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<tr>
<td>1000m</td>
<td>0.57°</td>
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</table>
Using your map & compass to measure current local magnetic declination

Compass Trail Jct -> Peak 52° Mag.

From the map Trail Jct -> Peak 68° True

Current local magnetic declination is (68 - 52) 16° E. of True North
Check your compass & sighting technique using these methods and the declination for the area

• Find some place near your home to establish your personal compass testing location.
• Identify several features, at least 1km away, that you can sight on.
• Use a map to determine True bearings to these features. Convert these bearings to Magnetic using the calculated declination for the area.
• Check your compass and technique. Experiment with your gear to see if it influences your compass.
• Keep notes, so you can repeat this in the future.