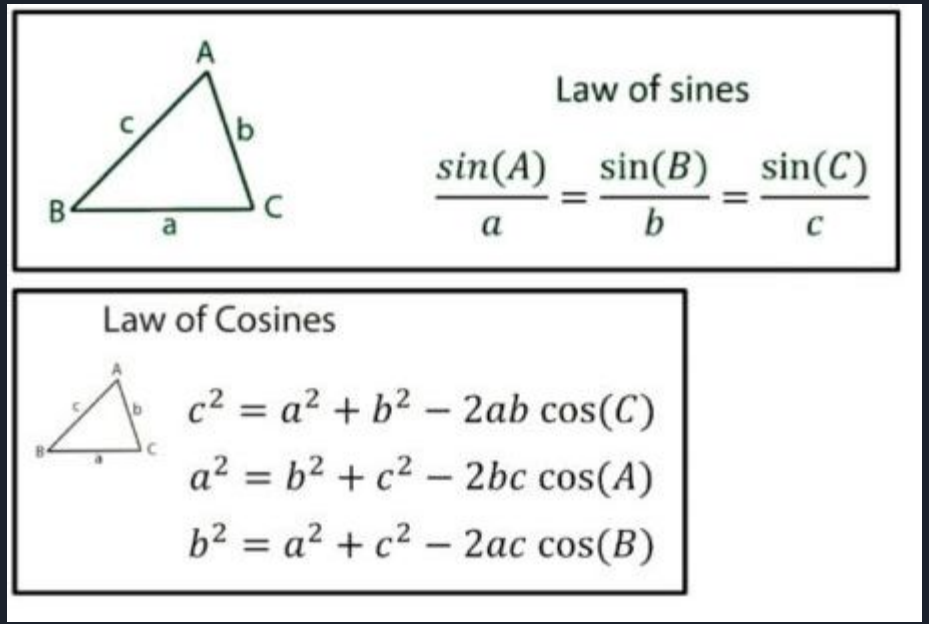
ProgTeam Spring Week 3

Geometry

Important properties:



Floating Points (The Short Version)

- Floating points will never be exact
- Two workarounds:
  - Comparing with epsilon, ex. `eps = 1e-7`
    - Ex. two points, P and Q
    - Don't: `if(P == Q){`
    - Do: `if(dist(P,Q) < eps){`
  - Keep everything integers
    - Don't: `if(sqrt(dx * dx + dy * dy) < r){`
    - Do: `if(dx * dx + dy * dy < r * r){`

Example: Binary Search

- When binary searching with floating points, don't use !=:
- Approach 1:

```
double lo = 0, hi = 100;
while(hi - lo > eps){
    double mid = (lo + hi) / 2;
```

- Approach 2:

```
double lo = 0, hi = 100;
for(int i = 0; i < 100; i++){
    double mid = (lo + hi) / 2;
```

- 2^{100} > 30 digits of precision, so this is pretty much always enough

Note: formatting output

- Unless problem says otherwise, print more digits to avoid rounding errors (10-20 is plenty)
- Example in different languages, print to 10 decimal places
- Java:
  - `println( String.format("%.10f", 3 / 10.0)) );`
- Python:
  - `print('%.10f' % (3 / 10.0))`
- C++:
  - `cout << fixed << setprecision(10) << 3 / 10.0 << endl;`