# Explanation of compute\_ap Function

This document explains how the compute\_ap function works — it computes Average Precision (AP), a standard metric for ranking and retrieval systems.

## Function Purpose

The function computes Average Precision (AP) given:  
- ranks: indices (zero-based) where the relevant images appear in the ranked list.  
 Example: [0, 3, 5] means positives appear at ranks 0, 3, and 5.  
- nres: total number of relevant images (e.g., 3).

## Key Idea — Average Precision (AP)

Average Precision measures the area under the precision–recall curve (PR curve):  
  
 AP = Σ P(k) × ΔR(k)  
  
Where:  
- P(k): precision at cutoff k  
- ΔR(k): change in recall when the k-th relevant item is found  
  
This implementation approximates the area using trapezoidal integration.

## Step-by-Step Explanation

1. Initialization

nimgranks = len(ranks)  
ap = 0  
recall\_step = 1. / nres  
  
- nimgranks: number of relevant items found.  
- recall\_step: how much recall increases with each positive (uniform step of 1/nres).

2. Loop Over Relevant Items

for j in np.arange(nimgranks):  
 rank = ranks[j]  
  
Iterates over each relevant item’s position in the ranked list.

3. Compute Precision Before and After the Item

if rank == 0:  
 precision\_0 = 1.  
else:  
 precision\_0 = float(j) / rank  
  
precision\_1 = float(j + 1) / (rank + 1)  
  
- precision\_0: precision just before finding the (j+1)-th relevant image.  
- precision\_1: precision just after it.

4. Integrate Using the Trapezoidal Rule

ap += (precision\_0 + precision\_1) \* recall\_step / 2.  
  
Computes the area under the local segment of the precision–recall curve.

5. Return Result

return ap  
  
Returns the average precision between 0 and 1.

## Example

Example:  
ranks = [0, 2, 4]  
nres = 3  
  
Relevant # | Rank | Precision | Recall  
----------- | ---- | ---------- | -------  
1 | 0 | 1.00 | 1/3  
2 | 2 | 2/3 | 2/3  
3 | 4 | 3/5 | 1.0  
  
The integrated area ≈ 0.86 (AP).

## Summary

|  |  |
| --- | --- |
| Concept | Meaning |
| ranks | Zero-based indices of relevant images |
| nres | Number of relevant (positive) images |
| Integration | Trapezoidal rule over precision–recall curve |
| Output | Average Precision (0–1 range) |