Triangulating the Apdex Metric with Barry-3

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Motivation

Better Performance Through Better Visualization
How High is Mt. Everest?

- Highest mountain in the world
  - How do we know that?
  - It’s a single number (like $A_1$)
- Estimates have varied
  - It’s rising a few mm each year
  - But moves northward several cm
  - GPS is less accurate for heights
- Surveyors solved this problem a long time ago
All Done with Triangles

- **Surveying procedure**
  - Triangulation
  - Start with short distances
  - Form triangular mesh

- **Great Trigonometric Survey of India**
  - How big is my colony?
  - Started by the British c.1790
  - George Everest joined in 1822
  - First estimate of Everest c.1850 was 8849m
  - Officially: 8848.82m

- **Computer graphics**
  - Similar idea
  - Triangular mesh for defining irregular shapes
Some Facts About Triangles

- In following, consider only equilateral $\triangle$ (each interior angle = 60°)
- For $\triangle$ sides of length 2, height $h = \sqrt{3}$
  - For $\triangle$ sides of length 1, height $h = \sqrt{3}/2$
  - For $\triangle$ sides of length $2/\sqrt{3}$, height $h = 1$
- Bisector of each side also bisects opposite interior angle (30°)
The Centroid

- **Centroid** (P) or "center of gravity" is 1/3rd height of the \( \Delta \) \( (h) \)
- By symmetry, centroid is at 1/3rd length of each bisector (b and c)
- We see: \( a + a + a = h \) and also know \( b = c = a \)
- Therefore: \( a + b + c = h \) (sum rule)
Barycentric Point

- Even if point P is moved away from centroid
  - Sum rule: \( a + b + c = h \) still holds
  - True for any point inside the \( \Delta \)
- Choose \( h = 1 \) as a convenient normalization
- Any 3 metrics that sum to 1 can mapped to this coordinate system

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Apdex Categories

- **Categorical data**
  - Sampled RTT counts
  - Categorized by threshold time T
    - *Satisfied* \((0 < \text{Sat} < T)\)
    - *Tolerating* \((T < \text{Tol} < 4T)\)
    - *Frustrated* \((\text{Frus} > 4T)\)

- **Ratio of counts**
  - If total counts in any period is \(\text{Cnt}\), then \(\text{Sat} + \text{Tol} + \text{Frus} = \text{Cnt}\)
    - Equivalently: \((\text{Sat}/\text{Cnt}) + (\text{Tol}/\text{Cnt}) + (\text{Frus}/\text{Cnt}) = 1\)
  - **Think of each term as a percentage of \(\text{Cnt}\)**
    - Satisfied\% + Tolerating\% + Frustrated\% = 100\%
  - **More simply: \(s + t + c = 1\)**
    - Where: \(s = \text{Satisfied}\%, t = \text{Tolerating}\%, f = \text{Frustrated}\%\)

- **Barycentric coordinates**
  - \(s + t + c = 1\) means each triple \(\{s, t, c\}\) is a barycentric point
    - Only need a pair of \(\{s, t, c\}\) because of sum rule
Apdex Index

- **Apdex categories define Index**
  - \( A_T = s + t/2 \)

- **Application responsiveness**
  - \( A_T \) based on RTT counts e.g., Gomez
  - User-perceived performance (not system performance)

- **Single number \( A_T \) reported**
  - Aimed at Executive Mgrs.
  - Normalized range: \( 0 < A_T < 1 \)
  - Colored zones for \( A_T \) values

- **Some Limitations**
  - How to compare 5 geographic \( A_T \) values for the *same* appln? (Table?)
  - How to compare 5 geographic \( A_T \) values for 5 apps? (messy)
  - Most enterprises need to compare 100’s of apps? (give up?)
  - Also want to know how multiple \( A_T \) values change in time
Solution

Mapping Apdex to Barry-3
Any 3 metrics that sum to 1 can mapped to Barry-3 system
- Apdex categories: $s + t + f = 1$ (height)
- Arrows $\{s,t,f\}$ range from each side (min=0) to opp. interior angle (max=1)

Limitation
- Don’t know the numerical value of $A_T$
Adding Numerical Apdex Zones

- \( A_T \) zones are diagonal bands
  - NOTE: Zone edges are parallel to Barry t-axis
- Zone boundaries are lines of constant \( A_T \) (isoclines)
- Zones are actually independent of Barry-3 coordinates
Combining $A_T$ with Zones

- Can visually estimate the value $A_T$ from the Zone boundaries
Example $A_T$ Data in Barry-3

- Shown are 5 geographic measurements of the same application
  - Some points may cover each other
  - Most clustered near $s = 1$ apex in this sample
  - One straggler is near the centroid
- Data supplied by Peter Sevcik
Benefits of Barry-3

- Compact visualization
- Simultaneous metric display
  - Actual $A_T$ index is a point inside triangle
  - Apdex categories $\{s,t,f\}$ determine its position
- Disambiguation
  - Same $A_T$ index can have different values of $\{s,t,f\}$
  - Don’t pay attention if you don’t care
- Apdex zones become colored diagonal bands
- Multiple applications
  - Represent each app by different marks or colored points
  - More data without making Barry-3 triangle larger
- Animating Changes
  - Changes in performance appear as movement of points
  - Can represent historical record of $A_T$ index (“flight recorder”)

Slide 15
Sir Barry conquers Mt. Everest in 1953

Questions?

Thank You