What’s up?

- Site information
- POIs around / distances on earth
- KWIC index
- Suffix array
Maps with Airport Tiles
Airports and Navaids Markers
Map Data

• Maps can be configured interactively

• Predefined e.g.:
  – OSM Mapnik
  – ESRI image
  – HERE hybrid
  – FAA sectionals via vfrmap.com
  – Topo / hillshading

• Mercator projection is precomputed for markers
**tooltip Links to Airport Information**

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**General Information**

**Airport codes:** EBBR • BRU  
**Type:** large airport  
**Scheduled service:** yes  
**Location:** 50.90140 N, 4.48444 E / 50° 54.0' N, 4° 29.0' E  
**Elevation:** 184 ft / 56 m AMSL  
**Sun times:** BCT: 06:37, sunrise:07:12, sunset: 16:39, ECT: 17:14  
**Magnetic variation:** 1° E
Aviation Data

- Airport and navaid data from ourairports.com
- Magnetic variation is computed by getWMA
- Sunrise, sunset, twilights are computed by PHP
- Weather is taken from official site
- NOTAMs are taken from official site
- Weather and NOTAMs are cached
Future Aviation Data

• Check and complete current data with official data from AIP, AFD

• More data
  – Obstacles
  – Navigation lights
  – Airspace
  – These data are in PDF to be converted and parsed

• Web links (airports, flight schools, flying clubs...)
Software used

- PHP
- SQLite
- MySQL
- jQuery UI
- Leaflet
- StaticMapLite
- getWMA
- Commentics
Airports / Navaids Around

- Find nearest airports / navaids
- Compute distances
- We assume spherical earth (error < 2%)
- Haversine formula:

\[
d = \text{acos}(\sin(lat1) \times \sin(lat2) + \\
\quad \cos(lat1) \times \cos(lat2) \times \cos(lon2 - lon1)) \times \\
6371\text{km}
\]
Trigonometric Functions

• Haversine requires \( \sin \) and \( \cos \)
• Database might not provide these (e.g. sqlite)
• We can precompute \( \sin(lat) \) and \( \cos(lat) \)
• precomuting \( \cos(lon2 - lon1) \)?
• Quadratic complexity
• Too much, cannot be done

• Really?
Yes, we can!

- Trigonometric identity for angle differences
  \[ \cos(\text{lon}2 - \text{lon}1) = \sin(\text{lon}2) \times \sin(\text{lon}1) + \cos(\text{lon}2) \times \cos(\text{lon}1) \]
- Apply this identity to haversine formula
- Reduce complexity to linear
- We can precalculate all \( \sin \) and \( \cos \) values and by this also precalculate \( \cos(\text{lon}2 - \text{lon}1) \)
- No \( \sin / \cos \) computation in query
- Wider choice of databases / performance increase
Name Search

- GNIS data from BGA and NGA
- Simple Approach: use database
- Database index designed for read and write
- This gives suboptimal algorithms
- Performance sufficient for small datasets
- There are several 10 Mios items
- Optimizing for read might give higher performance
KWIC – Key Word In Context

• Search all words in all items
• Has been used at times of low computing power
• For instance in libraries
• Binary search allows fast finding of words
• Can be used to find word prefixes
• Autocomplete
Suffix Array

• Suffix array is a data structure
• Introduced in 1990 and still not very popular
• A suffix array is generated from a string
• Can be considered as KWIC extension
• Allows fast finding of substrings
• Autocomplete
Suffix Array Example (1)

- String: bananas
- Each suffix gets index
  - 0  bananas
  - 1  ananas
  - 2  nanas
  - 3  anas
  - 4  nas
  - 5  as
  - 6  s
Suffix Array Example (2)

• Sort according to suffixes
  3   anas
  1   ananas
  5   as
  0   bananas
  2   nanas
  4   nas
  6   s
Suffix Array

- Binary search finds item extremely fast
- Binary search is not trivial (see wikipedia.org)
- Searching a valid prefix will get an interval
- Generating suffix arrays is relatively fast
- Suffix arrays are not easily updatable
- Other sortings possible than alphabetical
Conclusion

- airspace-v.com provides aviation data
- Data is partially stored, partially retrieved
- Can be used for simulation or choosing routes
- No endorsement for navigation
- Edison: „Genius is one percent inspiration, ninety nine percent perspiration.“
Outlook

• Website is WIP (work in progress)
• Lots of extensions and improvements to come
• Validate data
• Introduce gamification - „been there, done that“
• Rework layout
• Can be used for other software – e.g. maps.me