a lot of power in a little structure

\[\{(,),\ldots,(,}\},,,\]

the *posit*

Lars Rönnbäck, copyleft © 2019
with ideas from player Emma Henrikson
A posit is a sort of statement neither true, nor false by itself but by thyself it could be either
*posits* are statements about the domain being modeled

\[
\begin{align*}
&\left\{ (,()\right\},,] \\
&\left\{ (,()\right\},,]
\end{align*}
\]
**unique identifiers** represent things in real life

\[
\begin{align*}
[(42, 555),] \\
[(43, 555),]
\end{align*}
\]
roles describe the context in which things appear

\[
\text{[[(42, member), (555, group)],,],}
\text{[(43, member), (555, group)],,]}
\]
the combination of a unique identifier and a role is called an appearance

\[
\{(42, \text{member}), (555, \text{group})\}, \{(43, \text{member}), (555, \text{group})\}
\]
a set of one or many appearances is called an appearance set

\[
\{ (42, \text{member}), (555, \text{group}) \},
\{ (43, \text{member}), (555, \text{group}) \}
\]
nothing appears without a value

\[\{(42, \text{member}), (555, \text{group})\}, \text{participating}\]

\[\{(43, \text{member}), (555, \text{group})\}, \text{participating}\]
values are always bound to their *time of appearance* which provides an ordering

\[
\left\{ (42, \text{member}), (555, \text{group}) \right\}, \text{participating}, 1962-06-17
\]

\[
\left\{ (43, \text{member}), (555, \text{group}) \right\}, \text{participating}, 1962-06-17
\]
values and timepoints
may be of \textit{complex or primitive} types
and assumed sufficiently precise

traditional \textit{attributes} are expressed using posits with one appearance

\begin{verbatim}
[[(42, name)], Arnold Palmer, 1929-09-10]
[[(43, name)], Jack Nicklaus, 1940-01-21]
[[(555, name)], Playoff Group, 1962-06-16 19:45]
\end{verbatim}

traditional \textit{relationships} are expressed using posits with more than one appearance

\begin{verbatim}
[[(42, member),(555, group)], participating, 1962-06-17]
[[(43, member),(555, group)], participating, 1962-06-17]
\end{verbatim}

values in relationships are often enumerations representing the lifecycle

\begin{verbatim}
\end{verbatim}
traditional *classification* is also expressed using posits.

Multiple simultaneously valid classifications are possible to express.

“Arnold and Jack are both professional golfers and sometimes players.”
introduce two new things that can have opinions

giving posits their own unique identifiers makes it possible to "talk" about them, using meta-posits

an assertion is a meta-posit that assigns a confidence level in the range \([-1, 1]\) to an existing posit, along with who or what is holding that opinion

\[
P112: \left\{ \left( 42, \text{has} \right), \left( 4712, \text{class} \right) \right\}, \text{classified}, 1962-06-14
\]

\[
P113: \left\{ \left( 43, \text{has} \right), \left( 4712, \text{class} \right) \right\}, \text{classified}, 1962-06-14
\]

\[
\text{P112:} \left\{ \left( 44, \text{asserter} \right) \right\}, 0.9, 2019-10-15
\]

\[
\text{P112:} \left\{ \left( 45, \text{asserter} \right) \right\}, -1, 2019-10-15
\]

\[
\text{P113:} \left\{ \left( 44, \text{asserter} \right) \right\}, 1, 2019-10-15
\]

\[
\text{P113:} \left\{ \left( 45, \text{asserter} \right) \right\}, 0, 2019-10-15
\]
a change happens when the same dereferencing set appears again with a different value and appearance time

\[
\{(44, \text{name})\}, \text{Lars Samuelsson}, 1972-08-20
\]
\[
\{(44, \text{name})\}, \text{Lars Rönnbäck}, 2004-06-19
\]
\[
\{(42, \text{member}),(555, \text{group})\}, \text{participating}, 1962-06-17
\]
\[
\{(42, \text{member}),(555, \text{group})\}, \text{disbanded}, 1962-06-18
\]
a correction is a series of assertions with the same dereferencing set, where the latest confidence is 0 it may be followed by a new opinion for a posit having the same roles as the one being corrected

\[
\begin{align*}
\text{P112:} & \quad \{(42, \text{has}), (4712, \text{class})\}, \text{classified}, 1962-06-14 \\
& \quad \{(P112, \text{posit}), (44, \text{asserter})\}, 0.9, 2019-10-15 \\
& \quad \{(P112, \text{posit}), (44, \text{asserter})\}, 0, 2019-10-17 \\
\text{P114:} & \quad \{(42, \text{has}), (4713, \text{class})\}, \text{classified}, 1962-06-14 \\
& \quad \{(P114, \text{posit}), (44, \text{asserter})\}, 1, 2019-10-17
\end{align*}
\]
relationships between classes can be expressed

[[4712, name], Player, 1860]
[[4713, name], Golf player, 1860]

[[4712, class], [4713, subclass], active, 2019-10-17]

[[4711, name], Professional Golfer, 1860]
[[4714, name], Amateur Golfer, 1502]

[[4714, class], [4711, progressed class], active, 2019-10-17]
a transitional round of golf

putting the posit in the zone
A scorecard is a sort of portable database that keeps track of how your golf round is progressing. Players have their own scorecard but also act as a marker, keeping the score of their fellow player.
the score is measured after each played hole
score = cumulative number of strokes - sum of pars

a leaderboard shows the scores of players as the game progresses and is updated when players move between holes

<table>
<thead>
<tr>
<th>Player</th>
<th>Played</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Nicklaus</td>
<td>13</td>
<td>-1</td>
</tr>
<tr>
<td>Arnold Palmer</td>
<td>13</td>
<td>-1</td>
</tr>
<tr>
<td>Bobby Nichols</td>
<td>14</td>
<td>E</td>
</tr>
<tr>
<td>Phil Rodgers</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>Gay Brewer</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>Tommy Jacobs</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>Gary Player</td>
<td>16</td>
<td>3</td>
</tr>
</tbody>
</table>
A typical round of competitive golf

The round commences

PLAYER
- a hole is played

MARKER
- a hole is played

SCORE KEEPER
- observe play

The round concludes

SCORING AREA
- scorecards are handed in
- scores are registered and approved

PLAYER
- record strokes on scorecard
- sync strokes if not obvious

MARKER
- record strokes on scorecard
- ask if not obvious

SCORE KEEPER
- report to leaderboard

Compare scorecards
- sign scorecard
- sign scorecard

How many truths are out there?
Scorecards and leaderboard after hole 1

| PLAYER   | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|----------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|
| Palmer   |   |   |   |   |   |   |   |   |   | 5  | 3  | 4  | 4  | 3  | 5  | 5  | 3  | 4  | 5  |
| Nicklaus | 4 |   |   |   |   |   |   |   |   | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 3  | 5  |

<table>
<thead>
<tr>
<th>MARKER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nicklaus</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>3</td>
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<tr>
<td>Palmer</td>
<td>5</td>
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<td>3</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Jack Nicklaus made a birdie on the first

<table>
<thead>
<tr>
<th>played</th>
<th>score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Nicklaus</td>
<td>1</td>
</tr>
<tr>
<td>Arnold Palmer</td>
<td>1</td>
</tr>
</tbody>
</table>
\[\{(1962, \text{name})\}, \text{US Open}, 1962\]

\text{P1}: \[\{(1962, \text{competition}), (42, \text{participant}), (1, \text{hole})\}, 5, 1962-06-14 08:15\]
\text{N1}: \[\{(1962, \text{competition}), (43, \text{participant}), (1, \text{hole})\}, 4, 1962-06-14 08:15\]

\[\{(47, \text{name})\}, \text{Mr. Scorekeeper}, 1931-01-01\]
\[\{(\text{P1}, \text{posit}), (42, \text{asserter})\}, 1, 1962-06-14 08:15\]
\[\{(\text{N1}, \text{posit}), (42, \text{asserter})\}, 1, 1962-06-14 08:15\]
\[\{(\text{P1}, \text{posit}), (43, \text{asserter})\}, 1, 1962-06-14 08:15\]
\[\{(\text{N1}, \text{posit}), (43, \text{asserter})\}, 1, 1962-06-14 08:15\]
\[\{(\text{P1}, \text{posit}), (47, \text{asserter})\}, 1, 1962-06-14 08:15\]
\[\{(\text{N1}, \text{posit}), (47, \text{asserter})\}, 1, 1962-06-14 08:15\]

\[\{(1962, \text{competition}), (42, \text{participant})\}, E, 1962-06-14 08:16\]
\[\{(1962, \text{competition}), (43, \text{participant})\}, -1, 1962-06-14 08:16\]
The round commences

- **PLAYER**
  - Hole 1 is played
  - Strokes are synced
  - Records strokes on scorecard

- **MARKER**
  - Hole 1 is played
  - Records strokes on scorecard

- **SCORE-KEEPER**
  - Observes play
  - Reports to leaderboard

**REFEREE**
- Pace of play warning
- On the clock

**SCORE-KEEPER**
- Observes play
- Reports to leaderboard

**SCORE-KEEPER**
- Observes play
- Reports to leaderboard

Real life doesn’t always follow process!
### Scorecards and leaderboard after hole 2

<table>
<thead>
<tr>
<th>PLAYER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>PAR</td>
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<td>3</td>
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<td>4</td>
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<tr>
<td>Palmer</td>
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<td>Nicklaus</td>
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</tbody>
</table>

<table>
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<th>MARKER</th>
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<th>6</th>
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<th>18</th>
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</thead>
<tbody>
<tr>
<td>PAR</td>
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<td>4</td>
<td>4</td>
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<td>3</td>
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<tr>
<td>Nicklaus</td>
<td>4</td>
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<tr>
<td>Palmer</td>
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</tr>
</tbody>
</table>

The leaderboard is showing the opinion of the scorekeeper, rather than that of Arnold Palmer.

<table>
<thead>
<tr>
<th>Player</th>
<th>Played</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Nicklaus</td>
<td>2</td>
<td>-1</td>
</tr>
<tr>
<td>Arnold Palmer</td>
<td>2</td>
<td>E</td>
</tr>
</tbody>
</table>
Arnold Palmer (42) is not asserting any strokes for hole 2 at this moment. The score keeper (47) did not have time to ask about the scores, so is therefore even less certain (0.7).
PLAYER

hole 1 is played

strokes are synced

records strokes on scorecard

hole 2 is played

stress

records uncertain strokes on scorecard

hole 3 is played

records uncertain strokes for two holes on scorecard

MARKER

hole 1 is played

records strokes on scorecard

hole 2 is played

records uncertain strokes on scorecard

hole 3 is played

asks marker about strokes

SCORE

KEEPER

observes play

reports to leaderboard

observes play

reports to leaderboard

Who has the best information?
Scorecards and leaderboard after hole 3

<table>
<thead>
<tr>
<th>Player</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<th>13</th>
<th>14</th>
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<th>16</th>
<th>17</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Palmer</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Nicklaus</td>
<td>4</td>
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</table>

<table>
<thead>
<tr>
<th>Marker</th>
<th>1</th>
<th>2</th>
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<th>4</th>
<th>5</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Nicklaus</td>
<td>4</td>
<td>3</td>
<td>4</td>
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<td></td>
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<tr>
<td>Palmer</td>
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<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

The leaderboard is unaware of the fact that there is a difference of opinion concerning hole 2.

<table>
<thead>
<tr>
<th>Player</th>
<th>Played</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Nicklaus</td>
<td>3</td>
<td>-1</td>
</tr>
<tr>
<td>Arnold Palmer</td>
<td>3</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td>Event details</td>
<td>Time</td>
</tr>
<tr>
<td>---</td>
<td>---------------</td>
<td>------------</td>
</tr>
<tr>
<td>P2:</td>
<td>[((1962, competition), (42, participant), (2, hole)), 3, 1962-06-14 08:30]</td>
<td></td>
</tr>
<tr>
<td>N2:</td>
<td>[((1962, competition), (43, participant), (2, hole)), 3, 1962-06-14 08:30]</td>
<td></td>
</tr>
<tr>
<td>N2B:</td>
<td>[((1962, competition), (43, participant), (2, hole)), 4, 1962-06-14 08:30]</td>
<td></td>
</tr>
<tr>
<td>P3:</td>
<td>[((1962, competition), (42, participant), (3, hole)), 4, 1962-06-14 08:45]</td>
<td></td>
</tr>
<tr>
<td>N3:</td>
<td>[((1962, competition), (43, participant), (3, hole)), 4, 1962-06-14 08:45]</td>
<td></td>
</tr>
</tbody>
</table>

Arnold Palmer (42) asserts posits for both hole 2 and hole 3, but has a conflicting opinion about hole 2.

The score keeper (47) reasserts the number of strokes on hole 2 with more certainty after talking to the marker.
All leaderboard posits up to and including hole 3

LP1: $\left\{(1962, \text{competition}), (42, \text{participant})\right\}$, E, 1962-06-14 08:16
LP2: $\left\{(1962, \text{competition}), (42, \text{participant})\right\}$, E, 1962-06-14 08:31
LP3: $\left\{(1962, \text{competition}), (42, \text{participant})\right\}$, E, 1962-06-14 08:46

LN1: $\left\{(1962, \text{competition}), (43, \text{participant})\right\}$, -1, 1962-06-14 08:16
LN2: $\left\{(1962, \text{competition}), (43, \text{participant})\right\}$, -1, 1962-06-14 08:31
LN3: $\left\{(1962, \text{competition}), (43, \text{participant})\right\}$, -1, 1962-06-14 08:46

the leaderboard has possible redundancy among its posits, so called \textit{restatements}, unless it is important to keep track of the fact that a value remains the same or if posits may arrive out of temporal order
A consensus is reached!
Scorecards and leaderboard after hole 4

|    | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|----|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|
| PAR| 5 | 3 | 4 | 4 | 4 | 4 | 4 | 3 | 5 | 5  | 3  | 4  | 4  | 4  | 4  | 4  | 3  | 5  |
| Palmer | 5 | 3 | 4 | 4 |   |   |   |   |   |    |    |    |    |    |    |    |    |    |
| Nicklaus | 4 | 4 | 4 | 4 |   |   |   |   |   |    |    |    |    |    |    |    |    |    |

|    | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|----|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|
| PAR| 5 | 3 | 4 | 4 | 4 | 4 | 4 | 3 | 5 | 5  | 3  | 4  | 4  | 4  | 4  | 4  | 3  | 5  |
| Nicklaus | 4 | 3 | 4 | 4 |   |   |   |   |   |    |    |    |    |    |    |    |    |    |
| Palmer | 5 | 3 | 4 | 4 |   |   |   |   |   |    |    |    |    |    |    |    |    |    |

the leaderboard is corrected, given the new knowledge of the number of strokes on hole 2

<table>
<thead>
<tr>
<th></th>
<th>played</th>
<th>score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack Nicklaus</td>
<td>4</td>
<td>E</td>
</tr>
<tr>
<td>Arnold Palmer</td>
<td>4</td>
<td>E</td>
</tr>
</tbody>
</table>
P2: $\left[ \left( 1962, \text{competition} \right), \left( 42, \text{participant} \right), \left( 2, \text{hole} \right) \right], 3, 1962-06-14 08:30$

N2: $\left[ \left( 1962, \text{competition} \right), \left( 43, \text{participant} \right), \left( 2, \text{hole} \right) \right], 3, 1962-06-14 08:30$

N2B: $\left[ \left( 1962, \text{competition} \right), \left( 43, \text{participant} \right), \left( 2, \text{hole} \right) \right], 4, 1962-06-14 08:30$

$\left[ \left( \text{P2, posit} \right), \left( 43, \text{asserter} \right) \right], 0, 1962-06-14 09:00$

$\left[ \left( \text{N2B, posit} \right), \left( 43, \text{asserter} \right) \right], 1, 1962-06-14 09:00$

LN1: $\left[ \left( 1962, \text{competition} \right), \left( 43, \text{participant} \right) \right], -1, 1962-06-14 08:16$

LN2: $\left[ \left( 1962, \text{competition} \right), \left( 43, \text{participant} \right) \right], -1, 1962-06-14 08:31$

LN3: $\left[ \left( 1962, \text{competition} \right), \left( 43, \text{participant} \right) \right], -1, 1962-06-14 08:46$

LN2c: $\left[ \left( 1962, \text{competition} \right), \left( 43, \text{participant} \right) \right], E, 1962-06-14 08:31$

LN3c: $\left[ \left( 1962, \text{competition} \right), \left( 43, \text{participant} \right) \right], E, 1962-06-14 08:46$

$\left[ \left( \text{LN2, posit} \right), \left( 47, \text{asserter} \right) \right], 0, 1962-06-14 09:00$

$\left[ \left( \text{LN3, posit} \right), \left( 47, \text{asserter} \right) \right], 0, 1962-06-14 09:00$

$\left[ \left( \text{LN2c, posit} \right), \left( 47, \text{asserter} \right) \right], 1, 1962-06-14 09:00$

$\left[ \left( \text{LN3c, posit} \right), \left( 47, \text{asserter} \right) \right], 2, 1962-06-14 09:00$

Jack Nicklaus (43) corrects the number of strokes by retracting and asserting anew.

the score keeper (47) retracts his opinion of two posits and asserts new and corrected posits.
Multiple truths are in play!
Scorecards and leaderboard after hole 5

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<th>4</th>
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the leaderboard can only show one score and cannot take alternative balls into account

<table>
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<th>played</th>
<th>score</th>
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<tbody>
<tr>
<td>Jack Nicklaus</td>
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<tr>
<td>Arnold Palmer</td>
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</tr>
</tbody>
</table>
Two alternative realities are in play and one is more probable than the other.

the score keeper (47) reports the most likely score to show on the leaderboard.