
1
williamhill.com

1993

1999

2008


Peter
Greg


The
HOLLYWOOD TOWER
Hotel

The Pragmatic Programmers

Programming Erlang

Software for a Concurrent World

Joe Armstrong

William HILL

peter **morgan**

head of **engineering**

extreme **scalability**

464 bets per **second** (2014)

massive **concurrency**

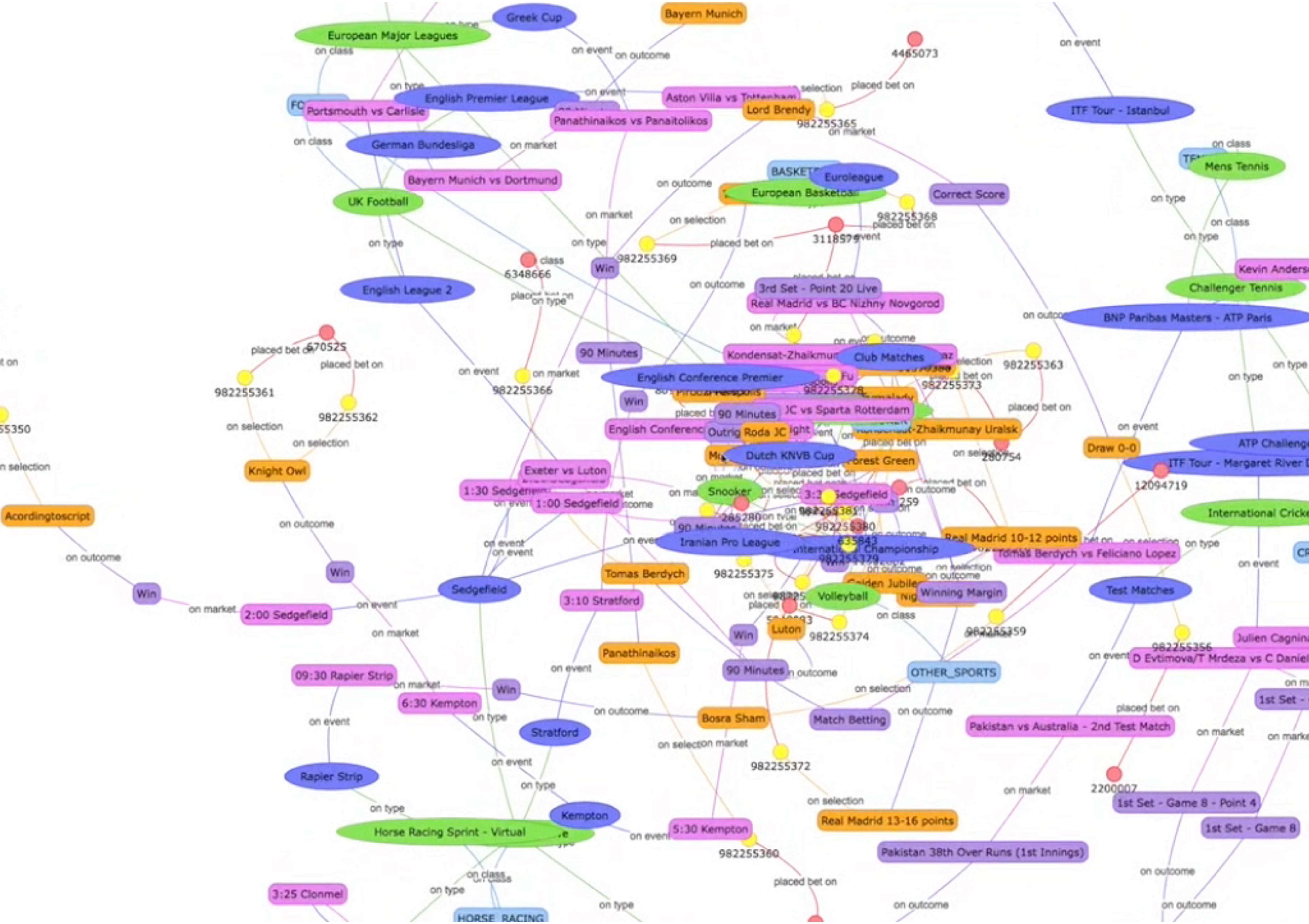
5,000,000 price changes per **day**

high **availability**

365x7x**24**

fault **tolerant**

160TB data through our networks **daily**



Greek Cup
Bayern Munich
European Major Leagues
4465073
ITF Tour - Istanbul
English Premier League
Portsmouth vs Carlisle
Aston Villa vs Tottenham
Lord Brendy
Panathinaikos vs Panaitolikos
982255365
German Bundesliga
Bayern Munich vs Dortmund
Mens Tennis
Euroleague
UK Football
Correct Score
982255368
3118579
6348666
Win
982255369
English League 2
Challenger Tennis
3rd Set - Point 20 Live
Real Madrid vs BC Nizhny Novgorod
BNP Paribas Masters - ATP Paris
670525
982255361
982255362
90 Minutes
Club Matches
English Conference Premier
982255366
982255363
982255373
Knight Owl
Acordingtoscript
Draw 0-0
280754
Dutch KNVB Cup
Roda JC
Exeter vs Luton
1:00 Sedgefield
Snooker
12094719
Iranian Pro League
Real Madrid 10-12 points
Tomas Berdych vs Feliciano Lopez
982255375
Tomas Berdych
Sedgefield
2:00 Sedgefield
3:10 Stratford
Volleyball
Winning Margin
Test Matches
Luton
982255374
982255359
982255356
Panathinaikos
OTHER_SPORTS
09:30 Rapier Strip
6:30 Kempton
Stratford
Bosra Sham
Match Betting
Pakistan vs Australia - 2nd Test Match
982255372
Rapier Strip
2200007
1st Set - Game 8 - Point 4
Kempton
Real Madrid 13-16 points
Horse Racing Sprint - Virtual
5:30 Kempton
1st Set - Game 8
982255360
Pakistan 38th Over Runs (1st Innings)
3:25 Clonmel
HORSE_RACING
on class
on type
on event
on market
on outcome
on selection
placed bet on

high level **architecture**

Trafalgar

Product Catalog

Recommendations

Bet Engine

Bet Capture

Settlement

Liability

Trading Platform

Feed Handlers

Match Coverage

Pricing Models

Pub

Resulting

Match State

Match Opinion

Trafalgar

Product Catalog

Trading Platform

Trafalgar

Recommendations

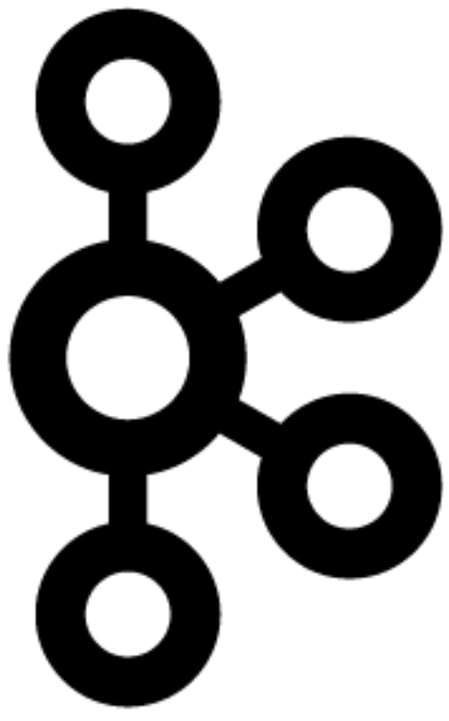
Bet Engine

Settlement

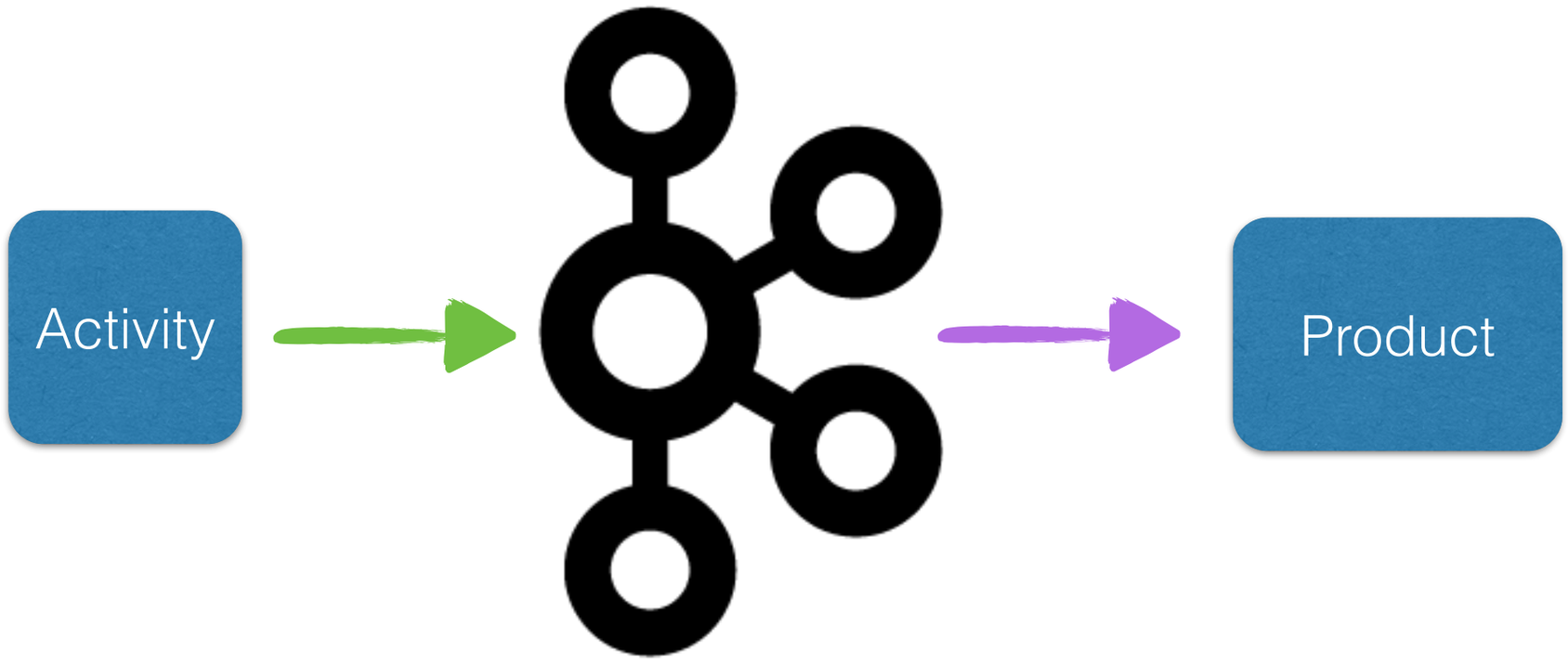
Trading Platform

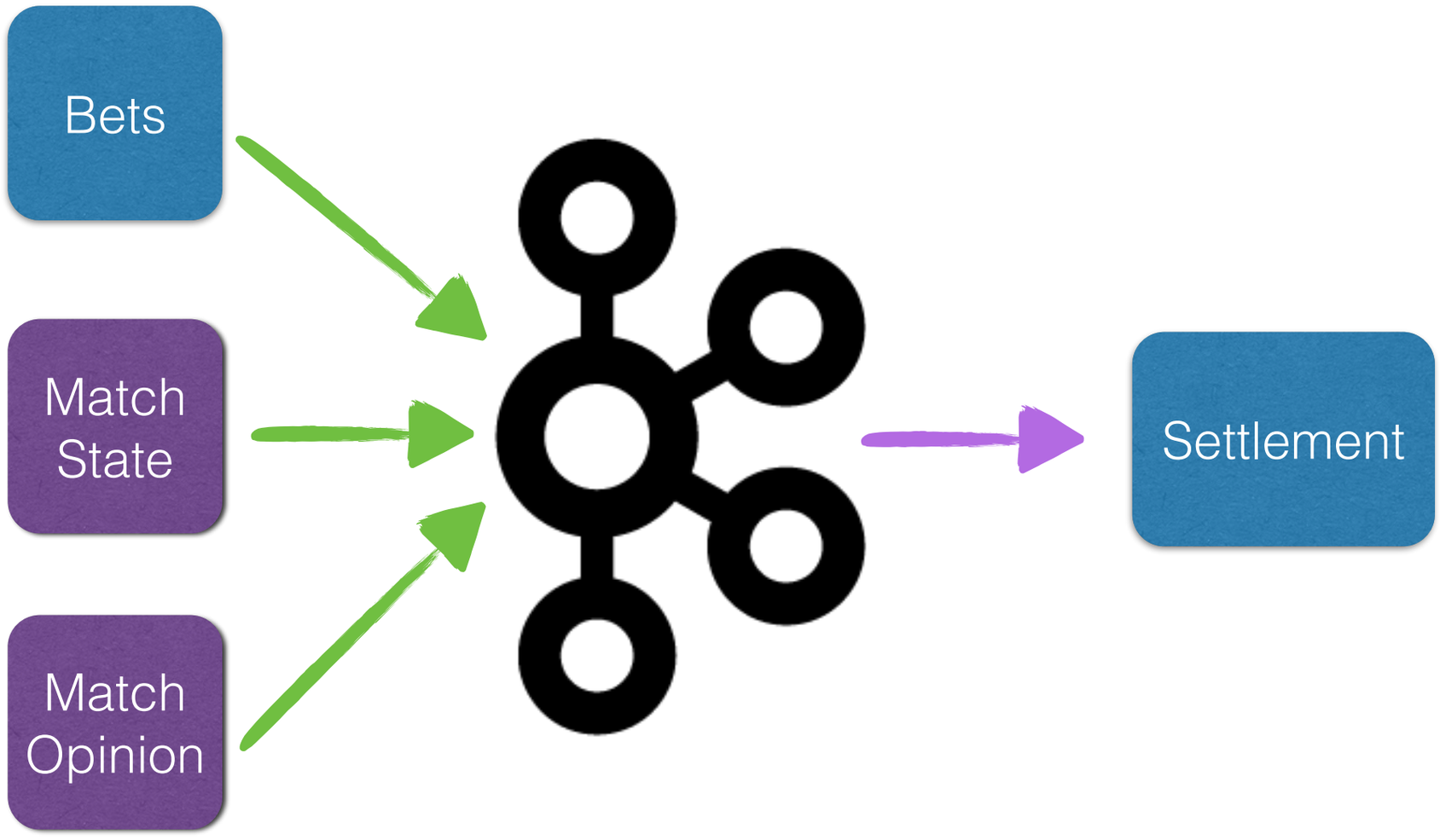
Feed Handlers

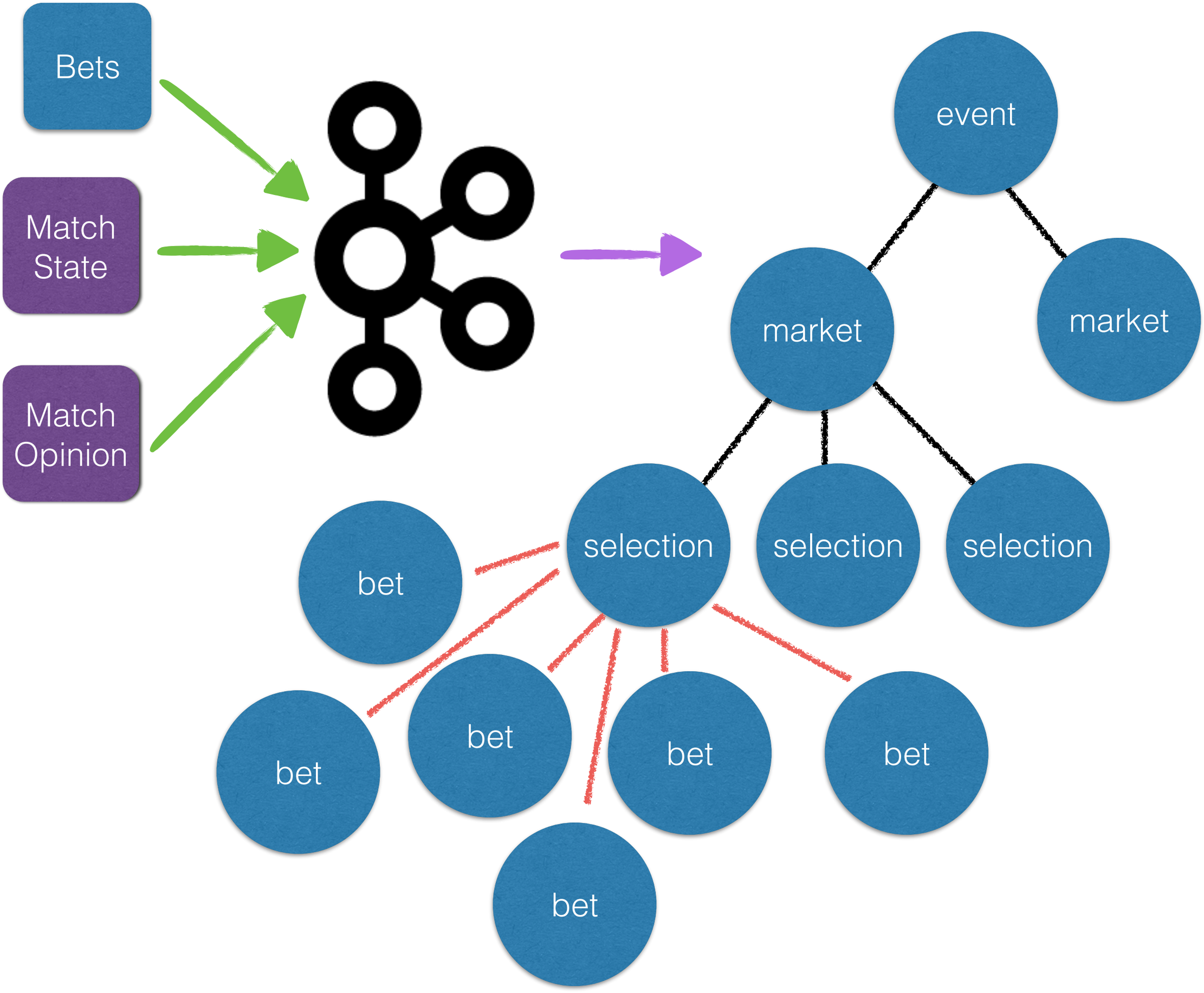
Match Coverage



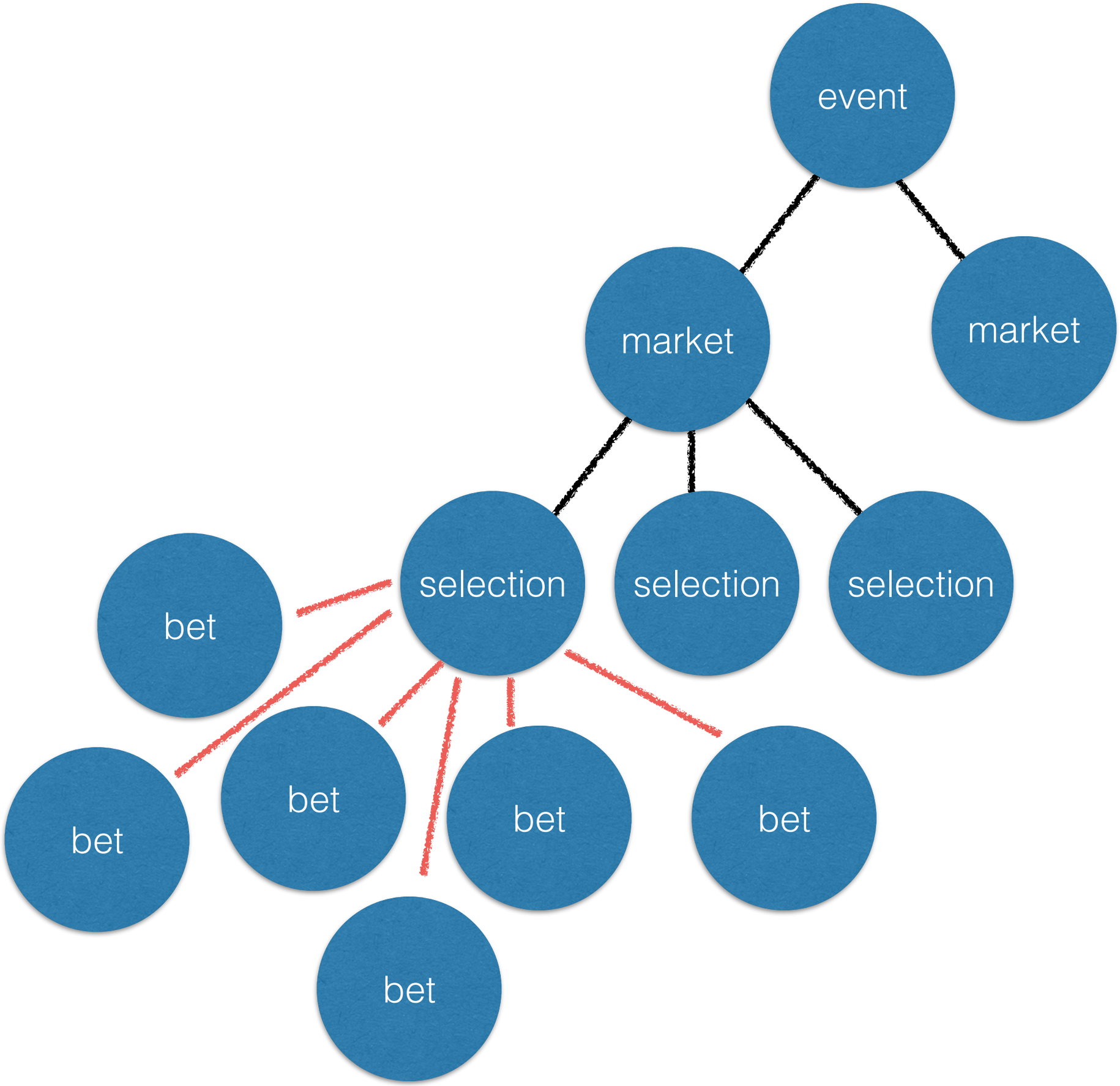
kafka


Activity
Product

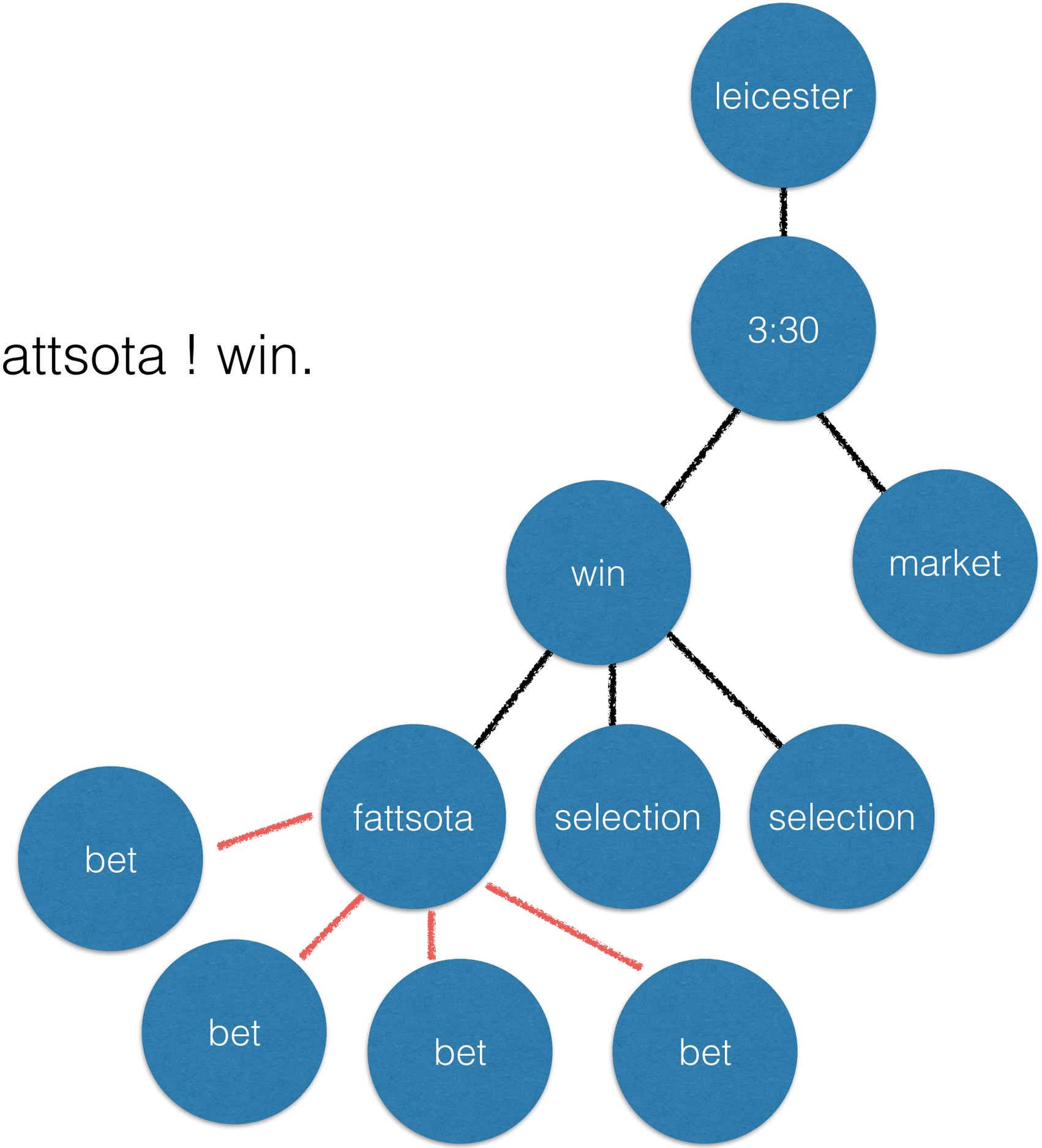

Bets
Match State
Match Opinion
Settlement


Bets
Match State
Match Opinion
event
market
market
selection
selection
selection
bet
bet
bet
bet
bet
bet

what if each vertex were a **process**?


event
market
market
selection
selection
selection
bet
bet
bet
bet
bet
bet

fattsota ! win.



sports betting **settlement**

Bet Engine

Settlement

Bet Engine

Settlement

Settlement

Settlement

Bet Engine

Settlement

Settlement

Settlement

Settlement

Settlement

Settlement

Settlement

Settlement

Settlement

will it be ~~**awesome**~~ ~~**suitable**~~ **evolvable**

enet — pmorgan@pm-dev-test:~/src/git — ssh — 123×34 — ⌘1

pmorgan@pm-dev-test:~/src/git | pmorgan@pm-dev-test:~/src/git/spbo | pmorgan@core-yum:~/src/git | bash

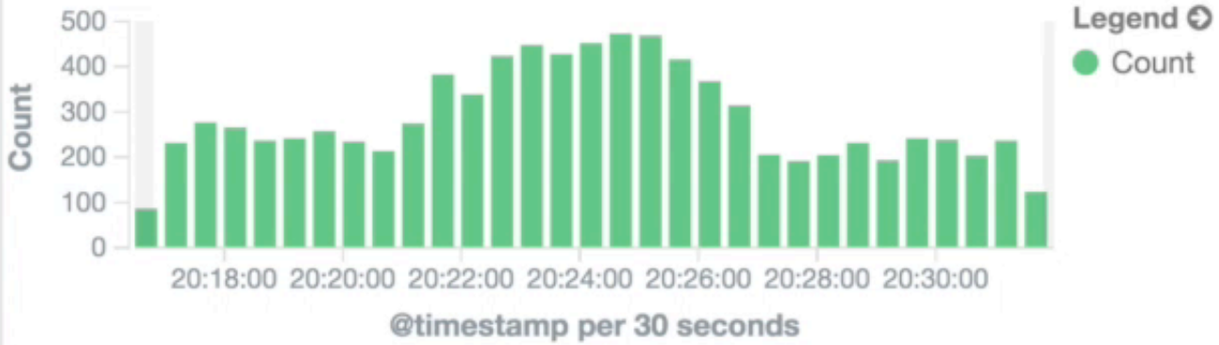
```
  1  [||||||||||||||||96.9%]   9  [||||||||||||||||98.2%]   17 [||||||||||||||||86.4%]   25 [||||||||||||||||98.8%]
  2  [||||||||||||||||99.4%]   10 [||||||||||||||||98.1%]   18 [||||||||||||||||98.8%]   26 [||||||||||||||||98.1%]
  3  [||||||||||||||||98.1%]   11 [||||||||||||||||98.8%]   19 [||||||||||||||||98.1%]   27 [||||||||||||||||98.1%]
  4  [||||||||||||||||99.4%]   12 [||||||||||||||||99.4%]   20 [||||||||||||||||98.8%]   28 [||||||||||||||||98.8%]
  5  [||||||||||||||||97.5%]   13 [||||||||||||||||98.8%]   21 [||||||||||||||||98.8%]   29 [||||||||||||||||97.5%]
  6  [||||||||||||||||99.4%]   14 [||||||||||||||||97.5%]   22 [||||||||||||||||98.8%]   30 [||||||||||||||||98.1%]
  7  [||||||||||||||||98.8%]   15 [||||||||||||||||98.8%]   23 [||||||||||||||||98.8%]   31 [||||||||||||||||97.5%]
  8  [||||||||||||||||97.5%]   16 [||||||||||||||||97.5%]   24 [||||||||||||||||97.5%]   32 [||||||||||||||||98.8%]
Mem[||||||||||                                  11831/129010MB]   Tasks: 41, 64 thr; 32 running
Swp[                                                0/4095MB]   Load average: 3.74 1.15 0.52
                                                                Uptime: 04:52:47

  PID USER      PRI  NI  VIRT   RES   SHR S CPU% MEM%   TIME+  Command
23800 pmorgan    20   0 14.1G 10.2G  2864 S 3083  8.1 22:13.68 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23841 pmorgan    20   0 14.1G 10.2G  2864 R 98.0  8.1  0:41.64 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23847 pmorgan    20   0 14.1G 10.2G  2864 R 98.0  8.1  0:40.71 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23844 pmorgan    20   0 14.1G 10.2G  2864 R 97.0  8.1  0:41.67 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23823 pmorgan    20   0 14.1G 10.2G  2864 R 97.0  8.1  0:41.71 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23827 pmorgan    20   0 14.1G 10.2G  2864 R 97.0  8.1  0:41.71 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23835 pmorgan    20   0 14.1G 10.2G  2864 R 97.0  8.1  0:41.16 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23828 pmorgan    20   0 14.1G 10.2G  2864 R 97.0  8.1  0:42.06 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23833 pmorgan    20   0 14.1G 10.2G  2864 R 97.0  8.1  0:41.93 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23850 pmorgan    20   0 14.1G 10.2G  2864 R 96.0  8.1  0:42.07 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23842 pmorgan    20   0 14.1G 10.2G  2864 R 96.0  8.1  0:41.91 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23824 pmorgan    20   0 14.1G 10.2G  2864 R 96.0  8.1  0:41.59 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23840 pmorgan    20   0 14.1G 10.2G  2864 R 96.0  8.1  0:42.06 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23831 pmorgan    20   0 14.1G 10.2G  2864 R 96.0  8.1  0:41.38 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23837 pmorgan    20   0 14.1G 10.2G  2864 R 96.0  8.1  0:41.10 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23822 pmorgan    20   0 14.1G 10.2G  2864 R 96.0  8.1  0:41.75 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23838 pmorgan    20   0 14.1G 10.2G  2864 R 96.0  8.1  0:42.10 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23836 pmorgan    20   0 14.1G 10.2G  2864 R 96.0  8.1  0:42.18 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
23848 pmorgan    20   0 14.1G 10.2G  2864 R 96.0  8.1  0:41.59 /home/pmorgan/opt/erlang-17.5/erts-6.4/bin/beam.smp -P 50000
F1Help  F2Setup F3SearchF4FilterF5Tree  F6SortByF7Nice -F8Nice +F9Kill  F10Quit
```

application **linking**

Discover Visualize Dashboard Settings Last 15 minutes

Bets *

Bet Count Histogram



Bet Count

8913

Count

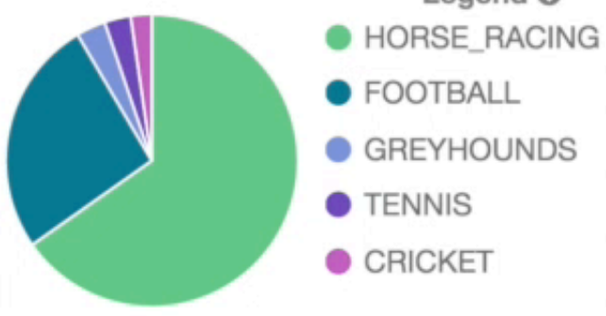
Amount (Sum of)

Table Request Response Statistics

Sum of amount_sys

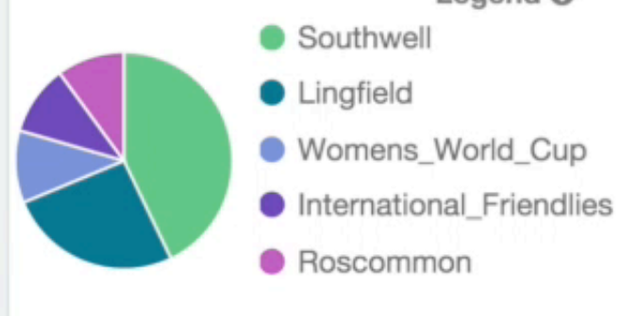
116364

Bet Hierarchy - Category N...

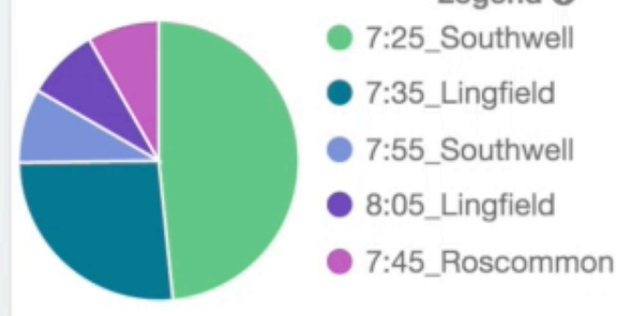


Bet Hierarchy - Class Name

Bet Hierarchy - Type Name



Bet Hierarchy - Event Name

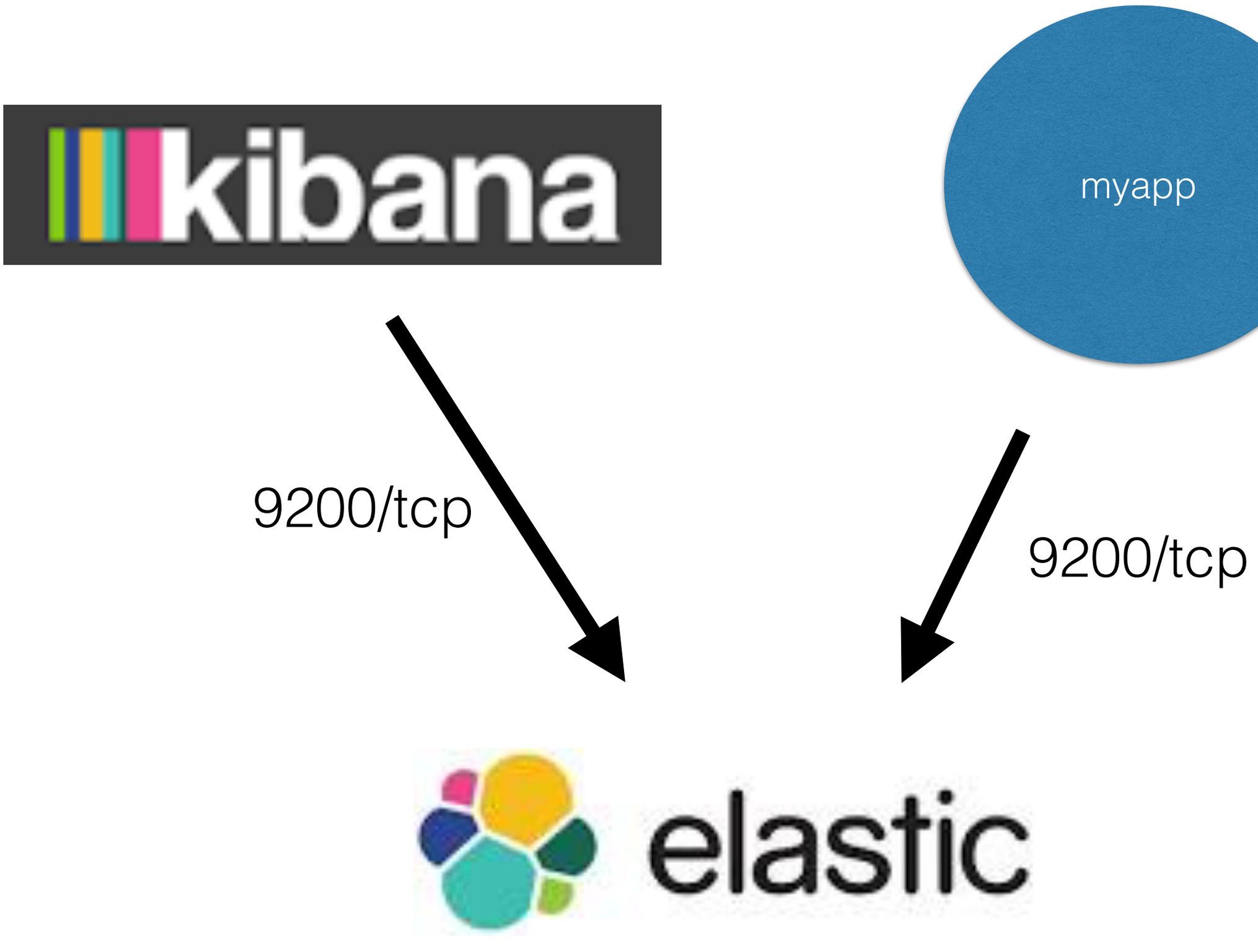


Bet Hierarchy - Market Name

Bet Hierarchy - Selection N...

Bet Type

Channel


kibana
myapp
9200/tcp
9200/tcp
elastic

dockerfile

```
FROM centos
COPY _rel/ /
EXPOSE 8080
ENTRYPOINT /myapp/bin/myapp console
```

docker-compose.yml

```
elasticsearch:
  image: elasticsearch
  ports:
    - "9200:9200"

kibana:
  image: shortishly/kibana
  links:
    - elasticsearch
  ports:
    - "5601:5601"
```

```
myapp:
    image: provider/myapp
    stdin_open: true
    tty: false
    ports:
      - "8080:8080"
    links:
      - elasticsearch
```

```
ELASTICSEARCH_PORT_9200_TCP_ADDR
ELASTICSEARCH_PORT_9200_TCP_PORT
```

```
{application, myapp, [
                      {description, "Myapp is great"},
                      {applications, [kernel, stdlib, gproc]},
                      {mod, {myapp_application, []}},
                      {env, [
                       {elasticsearch_port_9200_tcp_addr, "127.0.0.1"},
                       {elasticsearch_port_9200_tcp_port, "9200"},
                       {index_prefix, "logstash"}
                      ]}
                    ]}.
```

```
get_env(Key) ->
    gproc:get_env(l, ?MODULE, Key, [os_env, app_env]).

-spec tcp_addr() -> list().
tcp_addr() ->
    get_env(elasticsearch_port_9200_tcp_addr).

-spec tcp_port() -> list().
tcp_port() ->
    get_env(elasticsearch_port_9200_tcp_port).
```

https://github.com/shortishly/elastic

sports betting **recommendations**

Mathema

$$ax^2+bx+c=0$$

$$\frac{ax^2}{a}+\frac{bx}{a}+\frac{c}{a}=0$$

$$x^2+\frac{bx}{a}+\frac{c}{a}=0$$

$$\left(x+\frac{b}{2a}\right)^2-\left(\frac{b}{2a}\right)^2+\frac{c}{a}=0$$

$$\left(x\right.\qquad\frac{b^2}{4a^2}+\frac{c}{a}=0$$

$$\left.\right)=$$

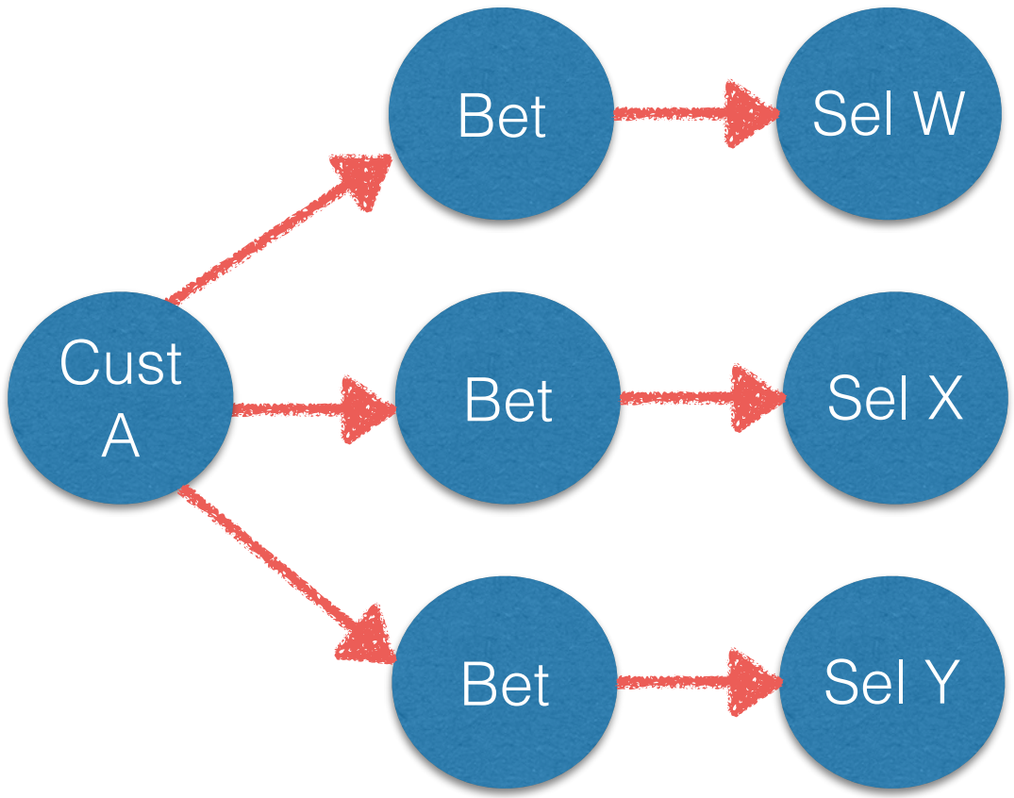
$$x=\pm 4+3$$

$$\Rightarrow x=+4+3=7$$

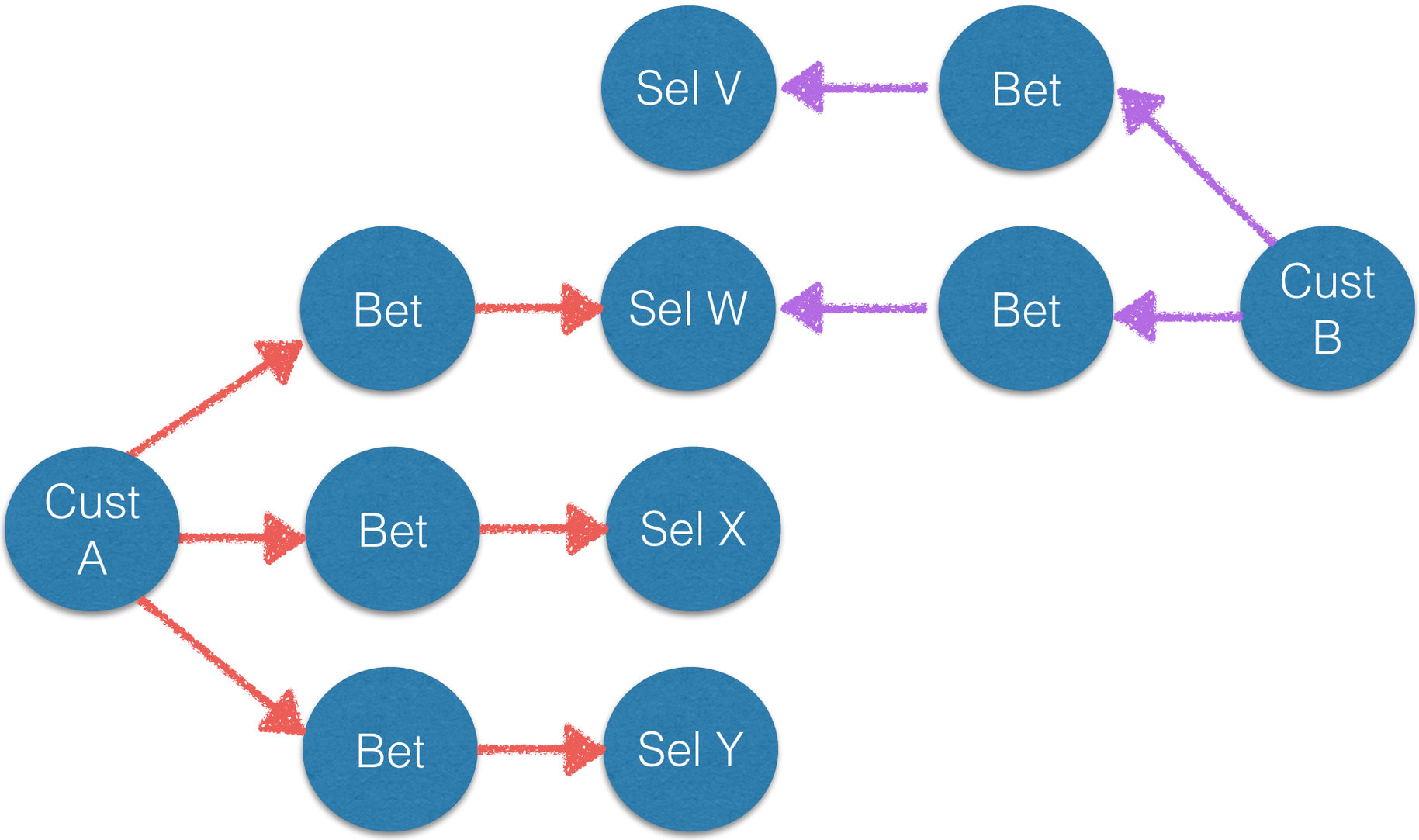
$$-4+3=-1$$

the **jaccard coefficient** measures similarity between finite sample sets, and is defined as the size of the **intersection** divided by the size of **union** of the sample sets:

J(A, B) = |A ∩ B| ÷ |A ∪ B|

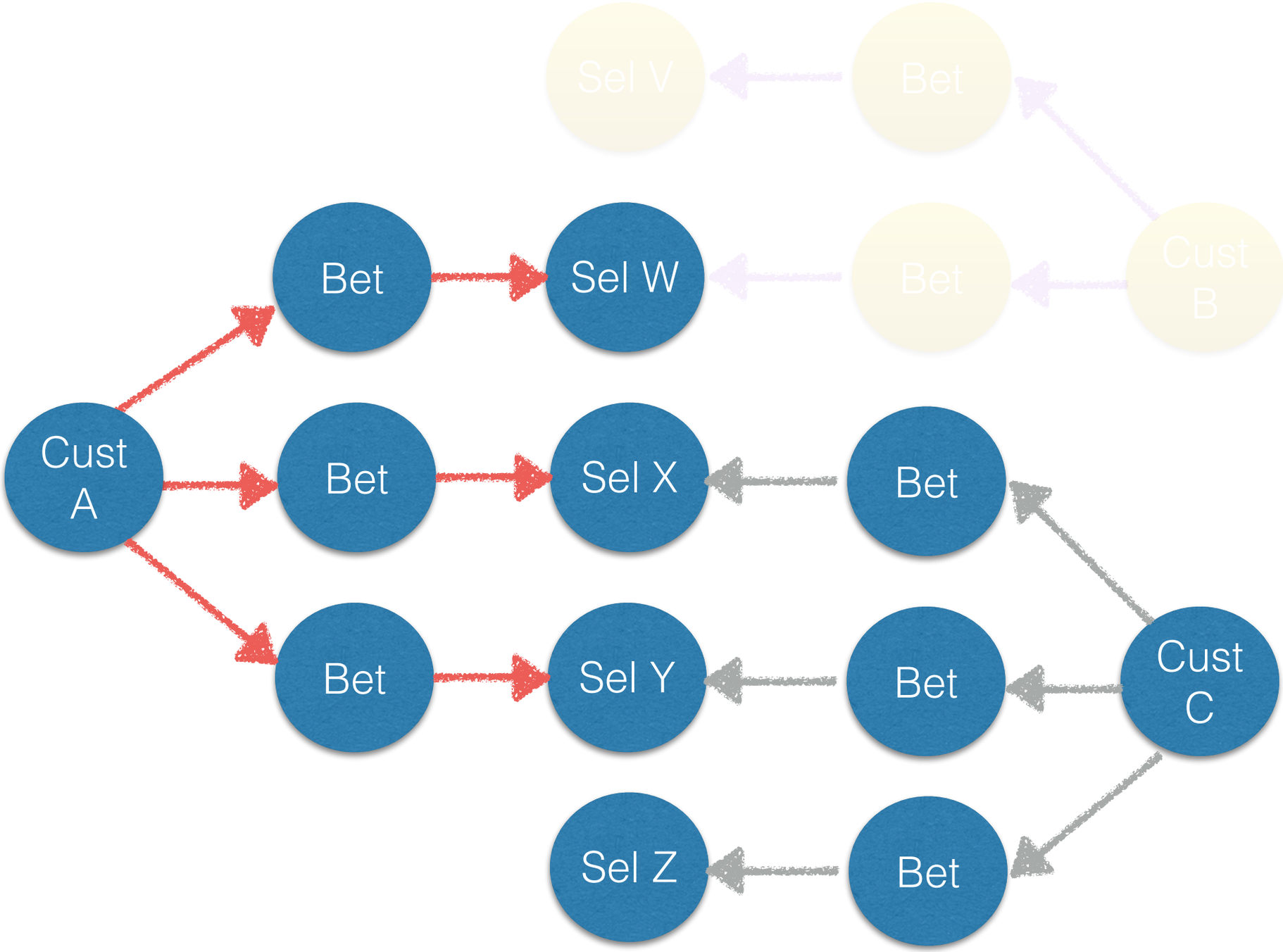

Bet
Sel W
Cust
A
Bet
Sel X
Bet
Sel Y

$$J(A, B) = |A \cap B| \div |A \cup B|$$



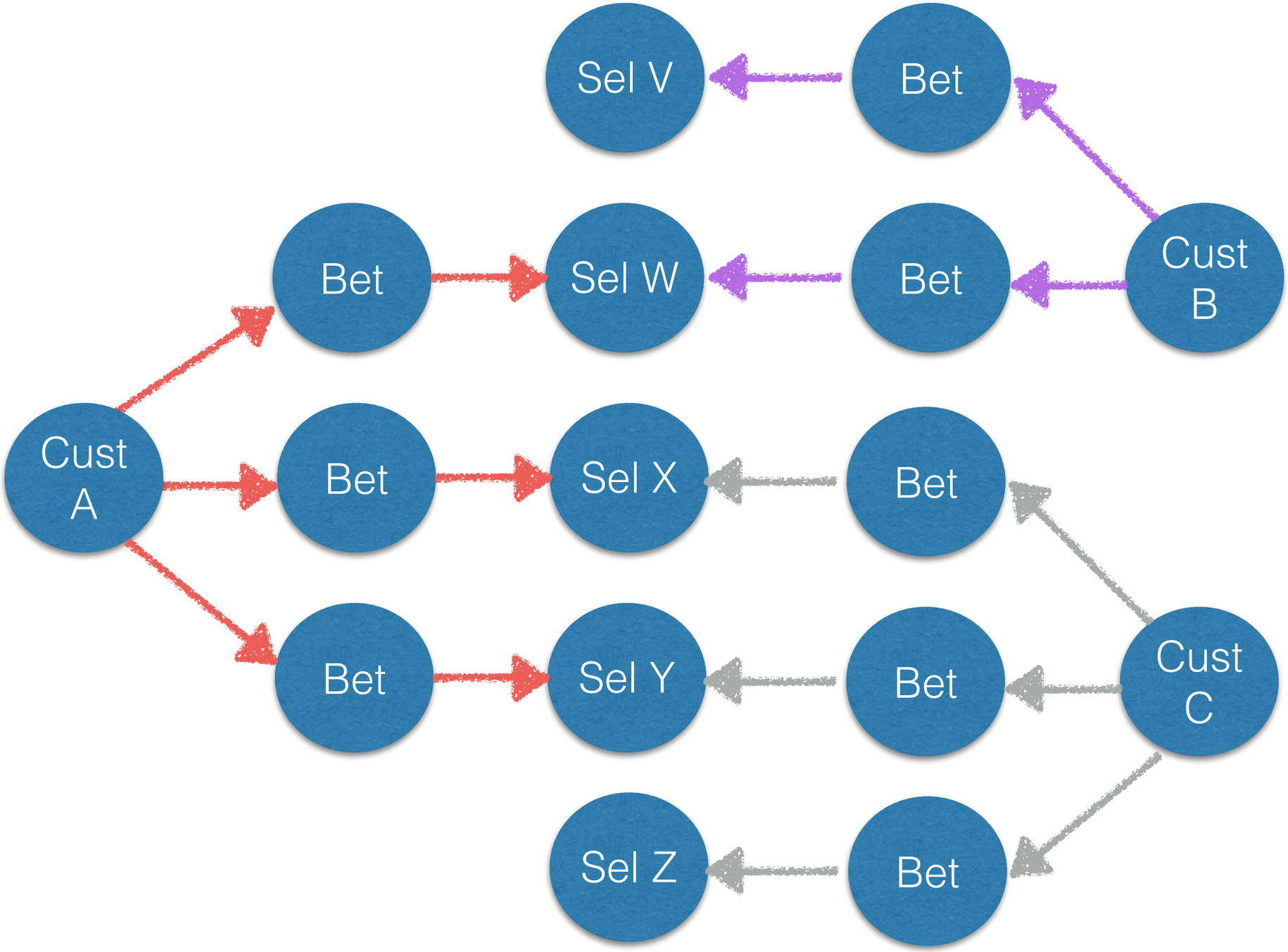
$$J(A, B) = |\{W, X, Y\} \cap \{V, W\}| \div |\{W, X, Y\} \cup \{V, W\}|$$

$$J(A, B) = |\{W\}| \div |\{V, W, X, Y\}| = 1/4$$



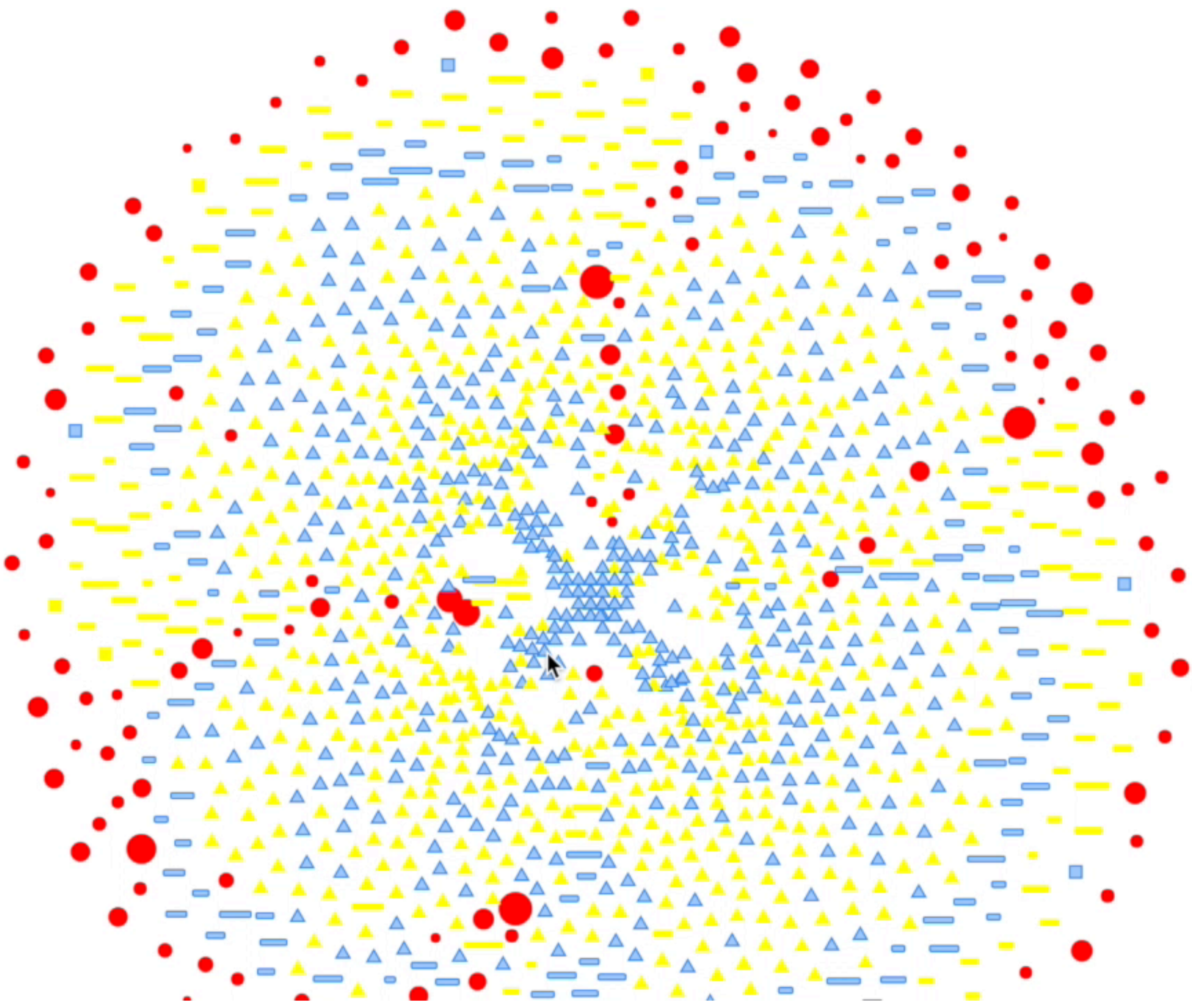
$$J(A, C) = |\{W, X, Y\} \cap \{X, Y, Z\}| \div |\{W, X, Y\} \cup \{X, Y, Z\}|$$

$$J(A, C) = |\{X, Y\}| \div |\{W, X, Y, Z\}| = 2/4$$



Recommendations for A = [{V, 0.25}, {Z, 0.5}]

sport **mapping**



kafka

docker

Scala

elastic

akka

node

spring

Java

Microsoft .net

ERLANG

puppet labs

riak

Spark

William HILL

http://www.williamhill.com/jobs

we are **hiring**