AI BUSINESS DRIVEN TRANSFORMATION:
BOOST OR HYPE?

AI Ukraine 2019

Quick Introduction

I am **Dmytro Fedyukov**,

Head of Data Science @ **SoftConstruct.io** Kyiv

SoftConstruct conducts basic and applied research in four key areas: data science, computer vision, big data, real-time processing. Our experience is extremely wide: from working with complex computer and engineering systems, programming for data science — to developing and putting into practice innovative solutions in the field of sports, eSports and security.

Area DefInition

Research Institute, Lab

- A new approaches, hypothesis
- Way to state-of-the-art
- ..new possibility in general
- Make world better
- Papers as product, maybe with code :)
- Fighting against restrictions
- Grant, research programs effectiveness

Product company on the market

- Product delivered to the clients
- Time to market
- Working service as product
- Manageable code base
- Dealing with environment restriction
- Dealing with integration restriction
- Investment effectiveness

In the beginning was the Dream, and the Dream was good.

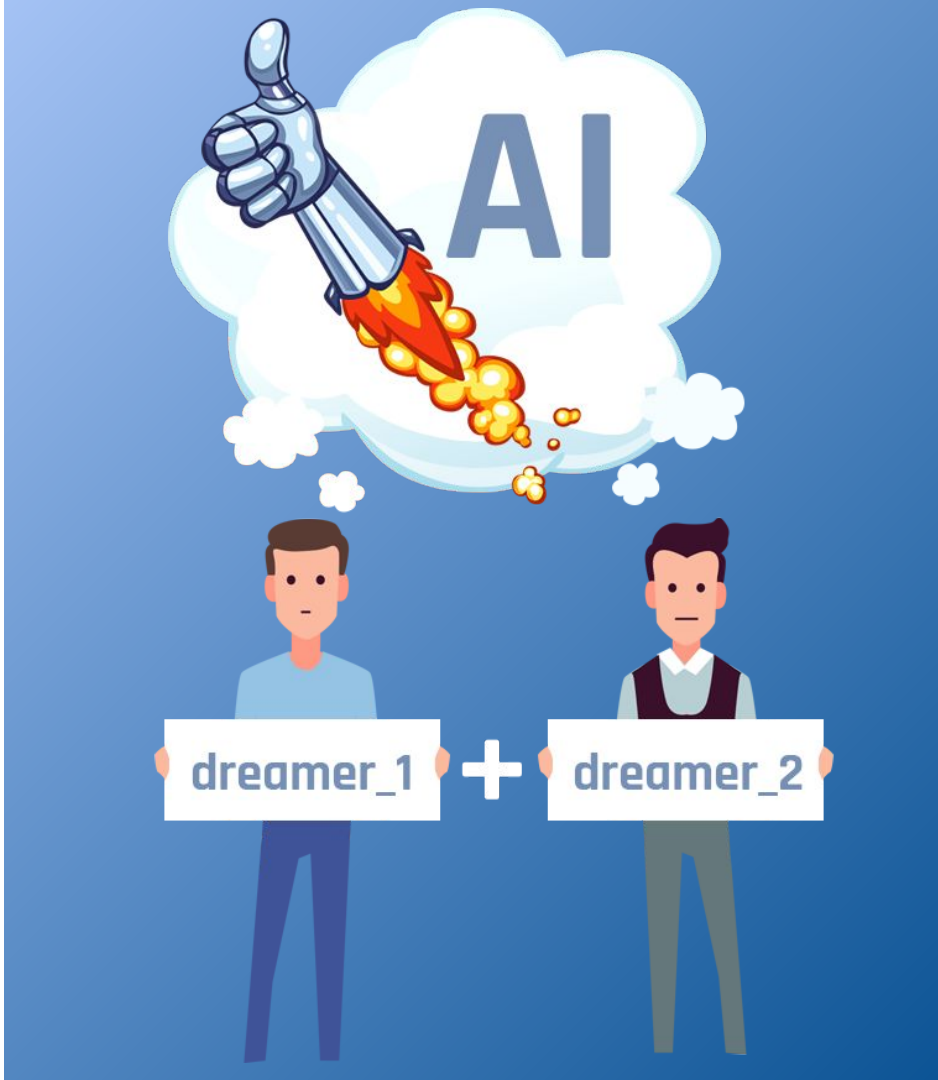
Stable business with market share

Recognizable brand on the market

> 400 partners on the platform in 11 geo zones

Two guys who dreamed about boost business with AI

SOFTCONSTRUCT,
2 years ago



Days gone...

That was the true Dream, kindles everyone who comes to the company.

Now around 60 people in 5 AI projects

Project areas: Risk management, fraud, detect image forgery / forensic

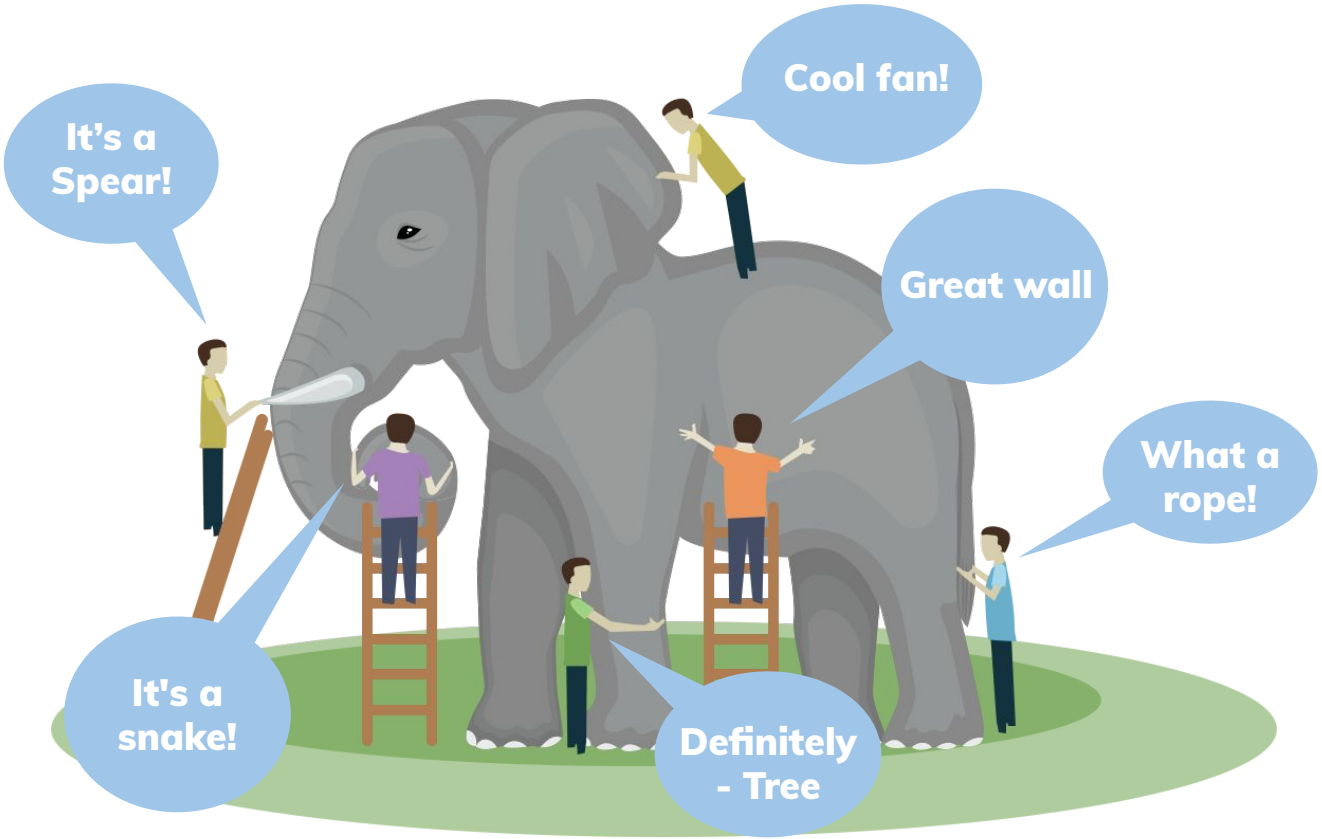
Sport tech : video semantic extraction, player effectiveness, tactical analysis

Real Time Stream, CV, quantitative analysis, Edge AI

SOFTCONSTRUCT,
our days

Lessons learned

What’s your Domen, man?



Optimal algorithm

When your first model simple and you have a manageable infrastructure

When you know the freshness requirements of your system

Problems detection before pushing model on prod

Start with interpretable model

Data

No matter how good your models are, they are only as good as your data

Practice says: recent or available data just isn't enough to predict always there. Is too much missing information and undefined influences around. Data always not enough.

Don't start project if you don't know where your data

18 games
recorded with our hardware

9 different stadiums
were captured

30+h of videos
tested with our system

>2m images
dataset

Auto-labeling
videotool

Data management

“Let's do it later” - It is great wrong strategy

Data sources readiness

Data quality

Version control schema : data + models

Controllability

+

+

Extra Metadata

Product

Don’t expect that the model you are working on now will be the last one that you will launch

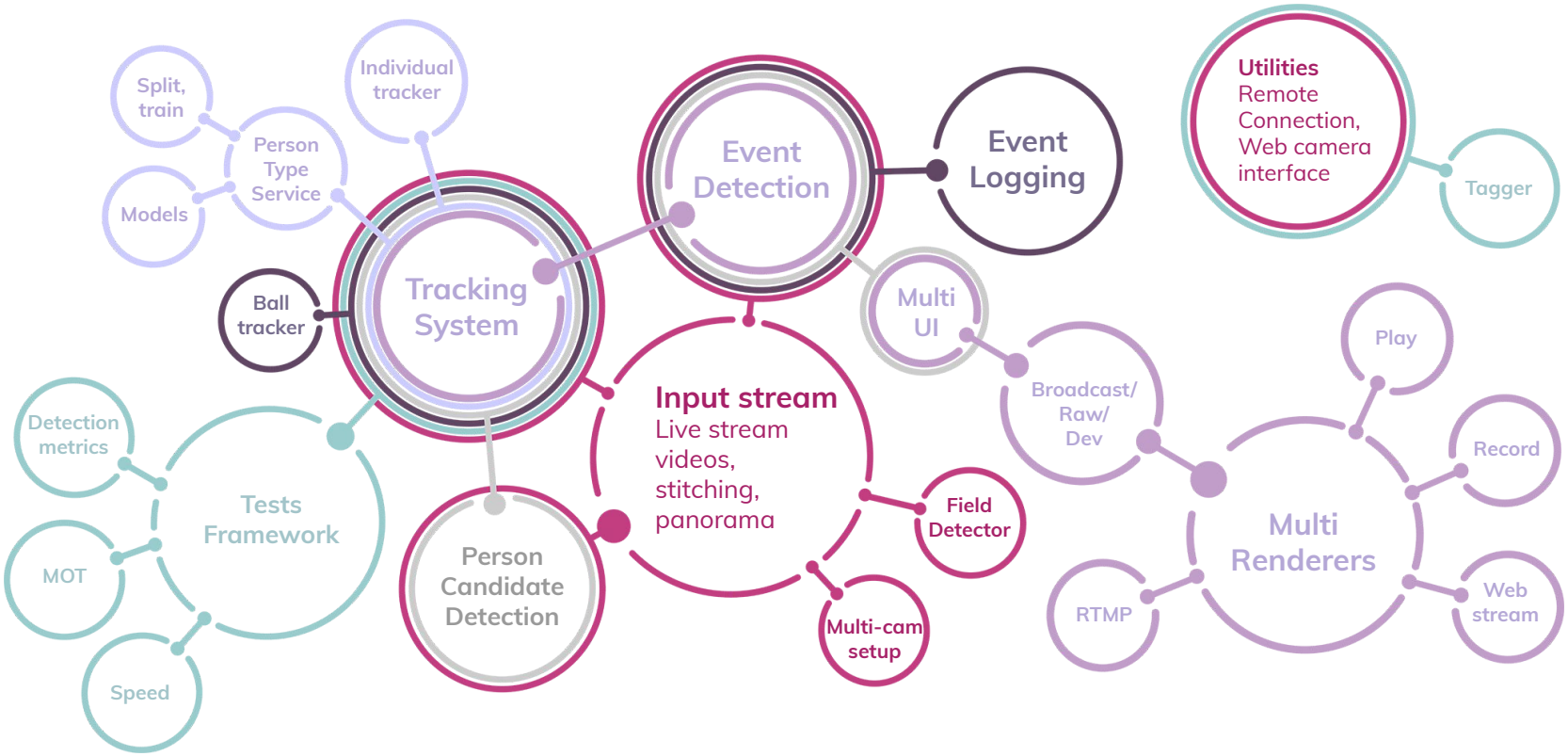
Don't be afraid to launch without ML, but prefer ML over a complex heuristic

You should always have an objective quantitative assessment of your changes.

Measure the delta between models.

Optimal : **build framework, manageable pipeline**

Product


Split, train
Individual tracker
Person Type Service
Models
Ball tracker
Tracking System
Event Detection
Event Logging
Utilities
Remote Connection, Web camera interface
Tagger
Multi UI
Broadcast/ Raw/ Dev
Play
Record
Web stream
Multi Renderers
RTMP
Input stream
Live stream videos, stitching, panorama
Field Detector
Multi-cam setup
Person Candidate Detection
Detection metrics
Tests Framework
MOT
Speed

Test - benchmark - profile

```
./main.py --test PersonTracking:#mot --corners-from-config --use-pretrained-team-classifier
```

```
Summary:
                FRAMES GT Recall Precision MT PT ML FP/frame FN/frame Switch/frame Lost/frame  MOTA  MOTP
full              1000 23  80.2%     85.4% 15  7  1     3.15     4.55         0.42       0.04 64.7% 71.7%
frames:0-100       100 23  76.5%     91.5% 14  8  1     1.64     5.40         0.04       0.04 69.2% 70.2%
frames:100-200     100 23  88.9%     88.9% 19  3  1     2.55     2.55         0.02       0.01 77.7% 73.8%
frames:200-300     100 23  87.0%     87.0% 18  4  1     3.00     3.00         0.08       0.07 73.6% 69.6%
frames:300-400     100 23  85.8%     85.8% 19  1  3     3.27     3.27         0.40       0.01 69.8% 70.5%
frames:400-500     100 23  75.3%     80.9% 16  3  4     4.08     5.67         0.78       0.02 54.2% 71.5%
frames:500-600     100 23  68.7%     82.6% 14  3  6     3.32     7.21         0.61       0.03 51.6% 72.2%
frames:600-700     100 23  78.0%     83.4% 14  7  2     3.58     5.07         0.51       0.02 60.2% 71.5%
frames:700-800     100 23  79.2%     82.0% 16  4  3     4.00     4.79         0.51       0.02 59.6% 73.0%
frames:800-900     100 23  81.5%     82.4% 19  0  4     4.00     4.26         0.79       0.00 60.7% 71.3%
frames:900-1000    100 23  81.6%     90.1% 19  0  4     2.06     4.24         0.44       0.01 70.7% 73.7%

Metrics description:
FRAMES       - total number of frames
GT           - number of unique groundtruth objects
Recall       - true positives / groundtruth positives
Precision    - true positives / predicted positives
MT           - 'mostly tracked': number of objects tracked for at least 80% of lifespan
PT           - 'partially tracked': number of objects tracked between 20% and 80% of lifespan
ML           - 'mostly lost': number of objects tracked less than 20% of lifespan
FP/frame     - false positives / number of frames
FN/frame     - false negatives / number of frames
Switch/frame - total number of track switches
Lost/frame   - total number of switches from tracked to not tracked
MOTA         - 'mot accuracy': 1 - (fn + switches + fp) / number of all gt objects appearances
MOTP         - 'mot precision': average distance value for true positives
```

Test - benchmark - profile

```
./main.py --test BallTracking:BallQuality --corners-from-config --multiple-ball-areas
```

```
./main.py --pipeline-type broadcast --test BroadcastUI:#accuracy
```

Metrics	Value
Frames	1500
Frames with ball	1251
Ball visible (% of frames with ball)	84.5
Ball in center zone (% of frames with ball)	60.8
Players in center zone - average	6
Players in center zone - median	6
0 players in center zone (% of frames)	3.4

```
./main.py --pipeline-type broadcast --test PersonCandidateDetection:#speed
```

```
./main.py --test PersonTracking:#determinism
…
```

Test - benchmark - profile

```
BroadcastUI signal processing duration (in seconds):
signal                      count        total         mean          min          max       median    99th percentile
-------------------------  -------  -----------  -----------  -----------  -----------  -----------  -----------------
BALL_STATE                    670  0.0285463    4.26065e-05  1.04904e-05  0.009022     2.59876e-05         8.92091e-05
FRAME_PROCESSING_FINISHED    1340  6.59752      0.00492352   6.19888e-06  0.0342135    0.00101352          0.0224347
NEW_FRAME                     670  4.29172      0.00640555   0.00328159   0.167054     0.00548327          0.0195191
PERSON_CANDIDATE_DETECTED     669  0.0769982    0.000115095  7.39098e-06  0.0052669    7.9155e-05          0.000903273
STREAM_INFO                     1  0.000628948  0.000628948  0.000628948  0.000628948  0.000628948         0.000628948
Total duration: 11.00 seconds


BallTracking signal processing duration (in seconds):
signal                      count       total         mean          min          max       median    99th percentile
-------------------------  -------  ----------  -----------  -----------  -----------  -----------  -----------------
NEW_FRAME                     671  15.5682     0.0232015    0.00594878   0.0745683    0.0146971           0.0677459
PERSON_CANDIDATE_DETECTED     670   0.0141108  2.10609e-05  7.62939e-06  0.00153089   1.45435e-05         5.31888e-05
STREAM_INFO                     1   3.21015    3.21015      3.21015      3.21015      3.21015             3.21015
Total duration: 18.79 seconds


PersonCandidateDetection signal processing duration (in seconds):
signal         count     total       mean         min         max     median    99th percentile
-----------  -------  --------  ---------  ----------  ----------  ---------  -----------------
NEW_FRAME        671  20.9047   0.0311546  0.00581479  0.0835006   0.0281644          0.0683036
STREAM_INFO        1   3.21918  3.21918    3.21918     3.21918     3.21918            3.21918
Total duration: 24.12 seconds


InputStream signal processing duration (in seconds):
signal                  count         total         mean          min          max       median    99th percentile
--------------------  -------  ------------  -----------  -----------  -----------  -----------  -----------------
READY_FOR_NEXT_FRAME     2010  44.8919       0.0223343    1.90735e-06  0.106913     9.05991e-06         0.0947219
STREAM_INFO                 1   0.000326395  0.000326395  0.000326395  0.000326395  0.000326395         0.000326395
Total duration: 44.89 seconds
```

Development cycle transformation

Hardware

Movidius an intel company

NVIDIA XAVIER

Coral

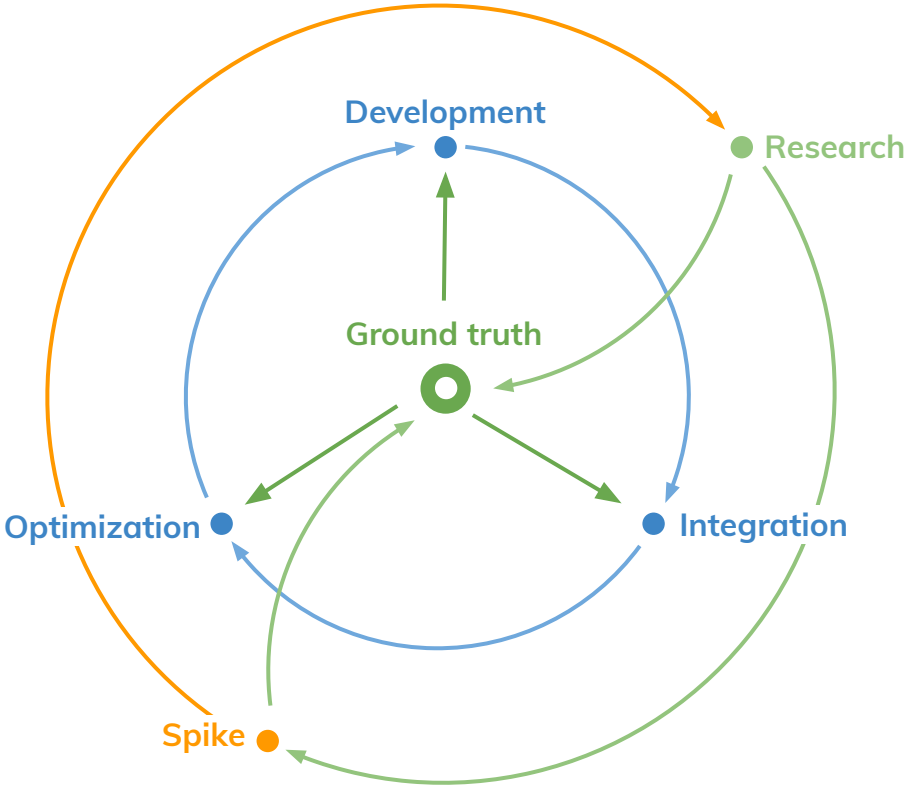
Frameworks

TensorFlow

TensorRT

PYTORCH

ArrayFire



arXiv.org

PubMed

PLOS

ResearchGATE scientific network

How it works: ICE 2019 Futsal tournament.

February 2019

Vanila Alpha-Pose
plus
Our optimization
=
x7 faster

High-precision, real-time, zero operator's assistance, video analysis tool for in-game events extraction, object tracking and situation reconstruction for advanced game analytics and sport betting applications.

Right people

Works

- System, critical thinking - be ready to answer “why this works in that way?”
- Specialization on board: Data Structures and Algorithms
- Ability to express oneself in code
- Balance of autonomy and interaction

Does't work

- Speed courses
- Magic thinking

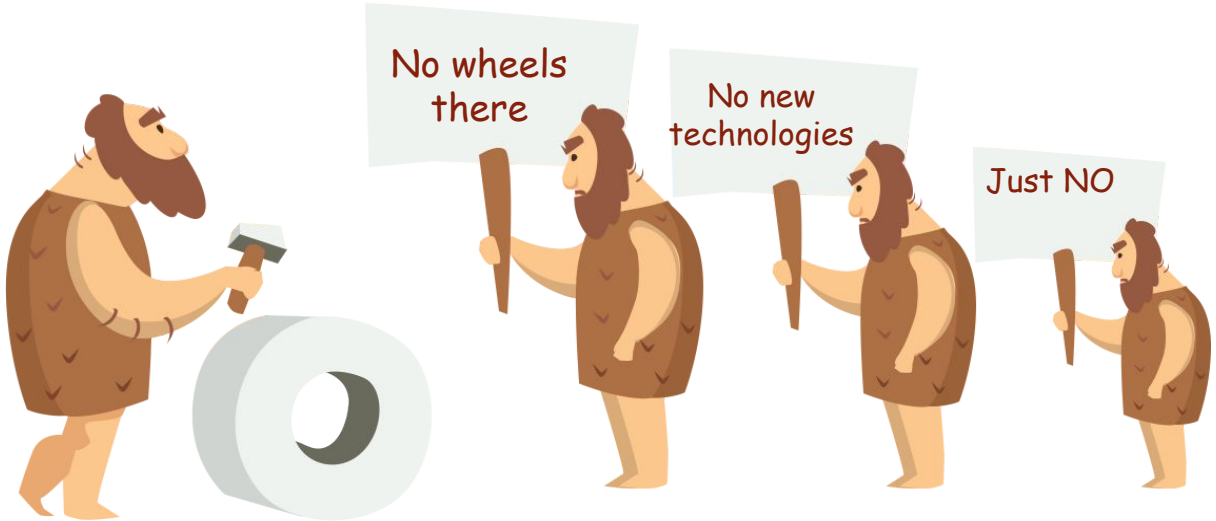
Integration and Resistance

AI It is always road to the operational effectiveness, means reducing the influence of a person in the mass and increasing the requirements for individual skills, broadening the horizon of opportunities.

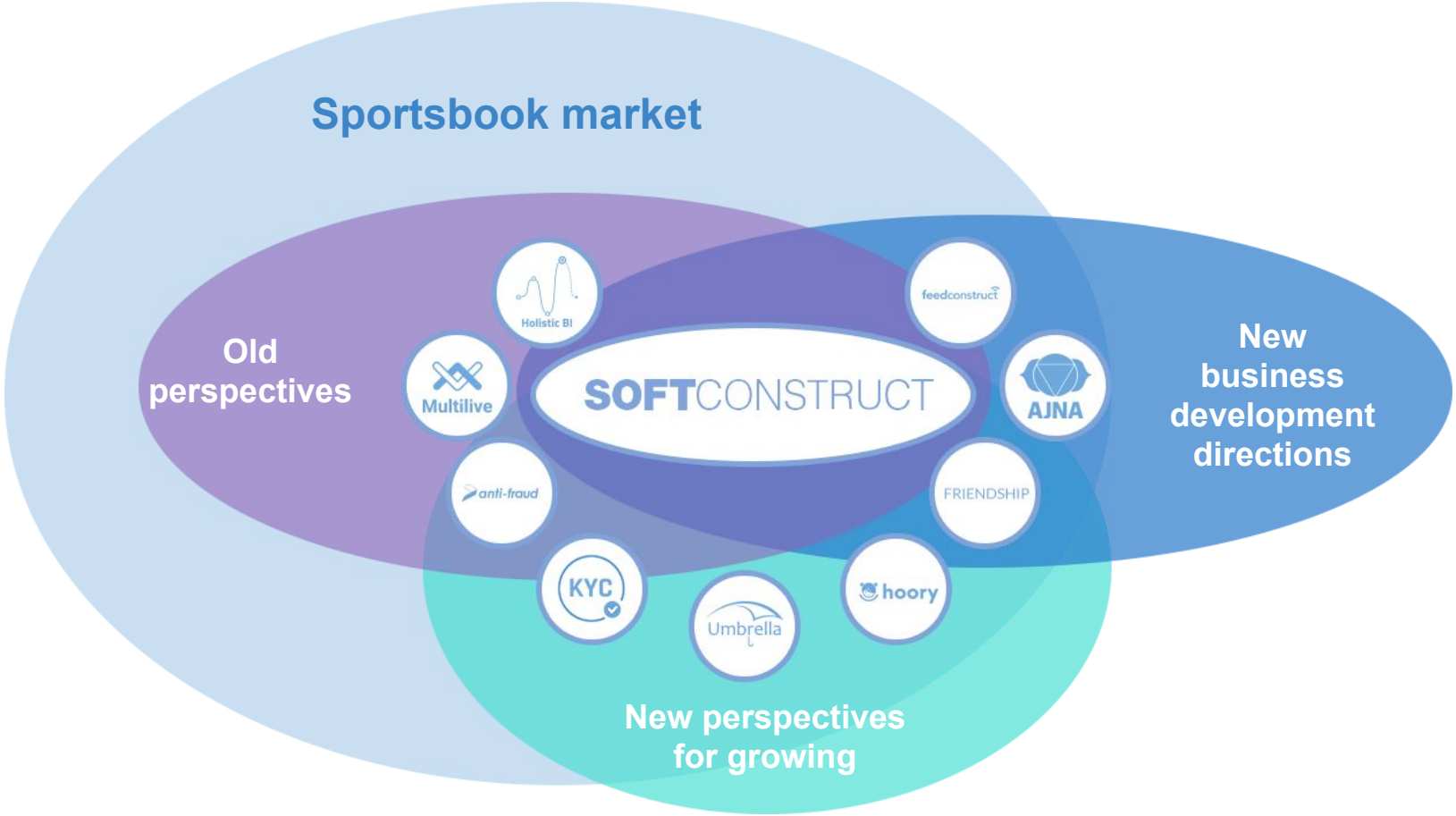
We can forgive a human without expecting 100% efficiency from him, but are not internally ready for this for AI powered automated systems.

Nothing happens without storytelling :)

Be a iterative

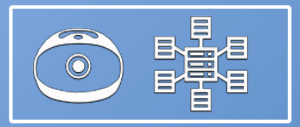


Business area extension



Game semantic ecosystem

Intellectual Cameras



- Live-streaming
- Augmented video
- Base Event log
- Video assets

Camera network management

Post-processing

Semantic library

Content enrichment

Tactical models

Video assets storage

Predictive Qualification models

API

Statistic / KPI

UI

Video Streaming

Semantic model

Consumers

B2B

Old b2b partners

Leagues

Digital media

Players/ Agents

Coaches/ Clubs

B2C Amateur

Our mentor and partner

Thanks!

Any Questions?

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