Microsoft Research

Microsoft

Probabilistic programming in production with Infer.NET

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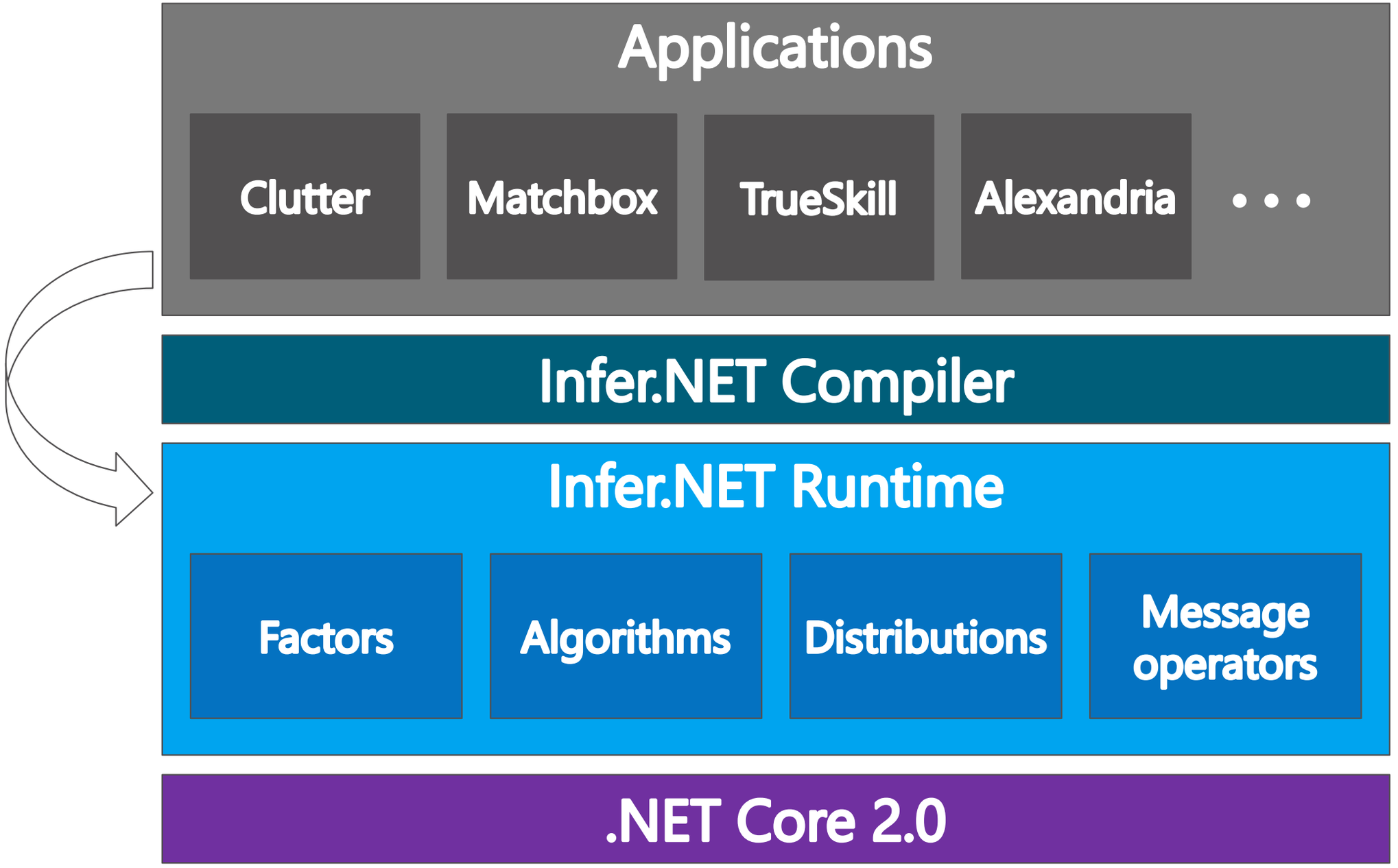
- Runs probabilistic inference in graphical models
- First public release in 2008
- Used in hundreds of research publications

  Won “Patents for Humanity” Award from USPTO
- Used in several Microsoft products

Announcement:
Infer.NET goes open source

https://github.com/dotnet/infer

- Released under the .NET Foundation and MIT license
- External contributions welcome
- Cross-platform support through .NET Core


Applications
Clutter
Matchbox
TrueSkill
Alexandria
• • •
Infer.NET Compiler
Infer.NET Runtime
Factors
Algorithms
Distributions
Message operators
.NET Core 2.0

Clutter
Personalized email classification

Office

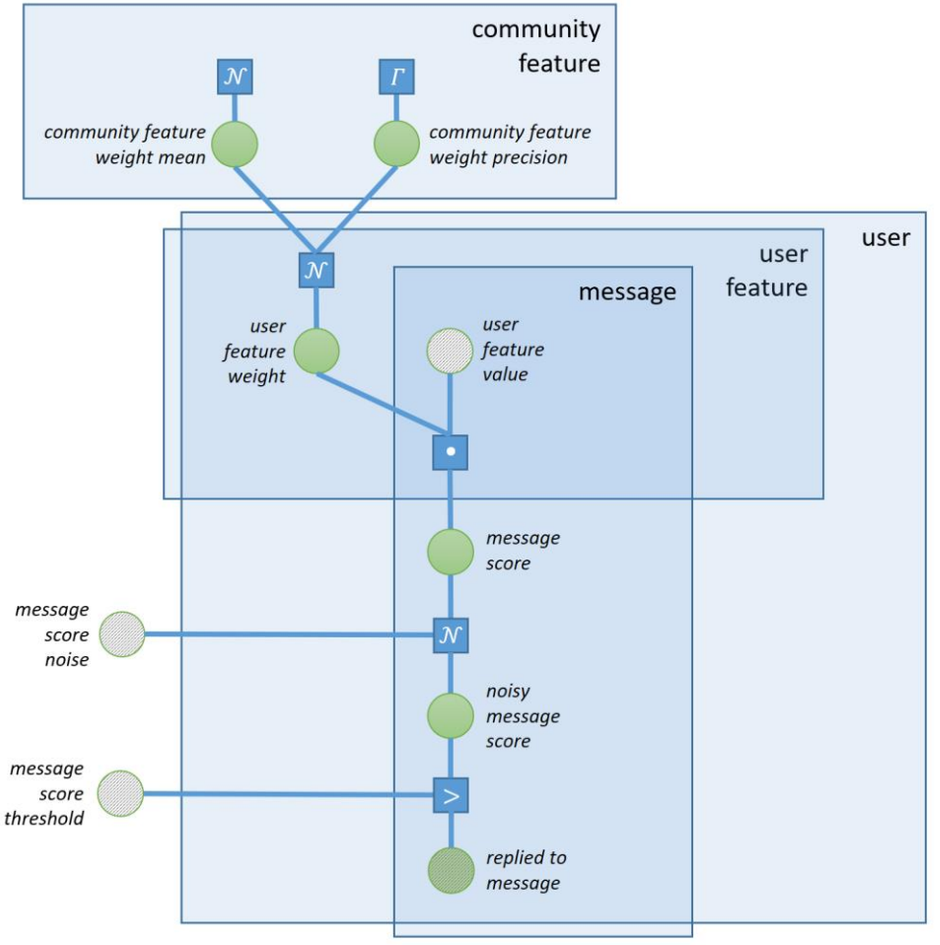
- De-clutter user's mailbox

  Based on past behaviour, e.g. replying to emails
- Hierarchical classifier

  1. Community training on historical data
  2. Gradual online personalization
- Launched in 2014 in Exchange

  Hundreds of millions of emails

  Tens of millions of users



TrueSkill

Skill rating for player matchmaking

- ## Model of player performance

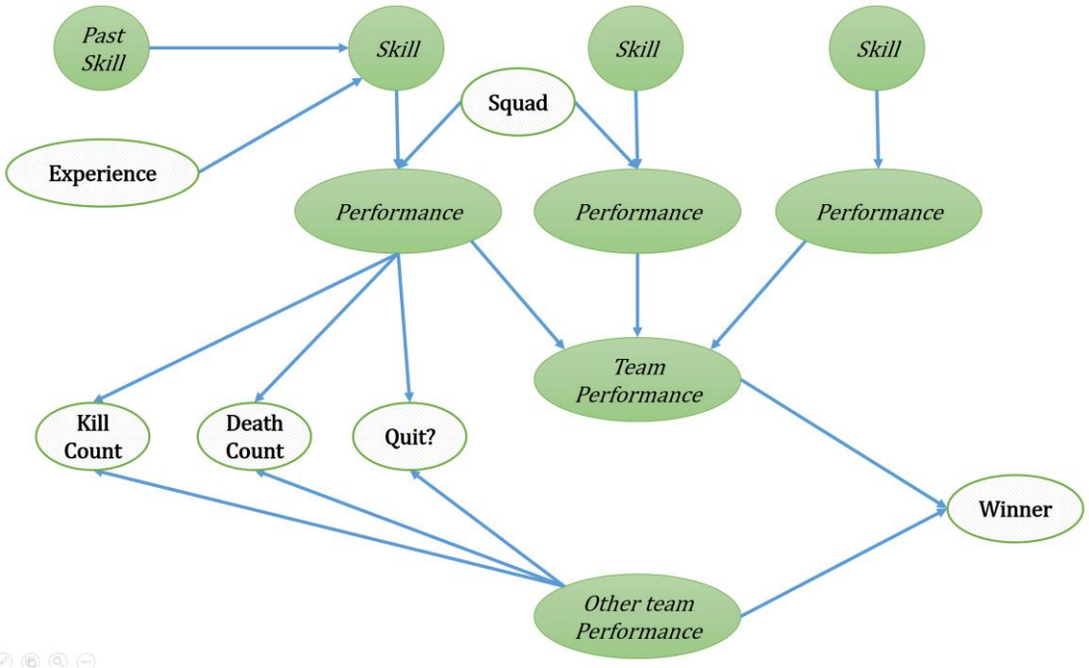
  Based on match participants and outcome as well as player experience, event counts and skill in other game modes

- ## Offline and online phase

  1. Learn model parameters on historical data
  2. Update skills as matches are played

- ## Live in Halo and Gears of War

  Processing hundreds of millions of matches



Matchbox
Personalized recommendations

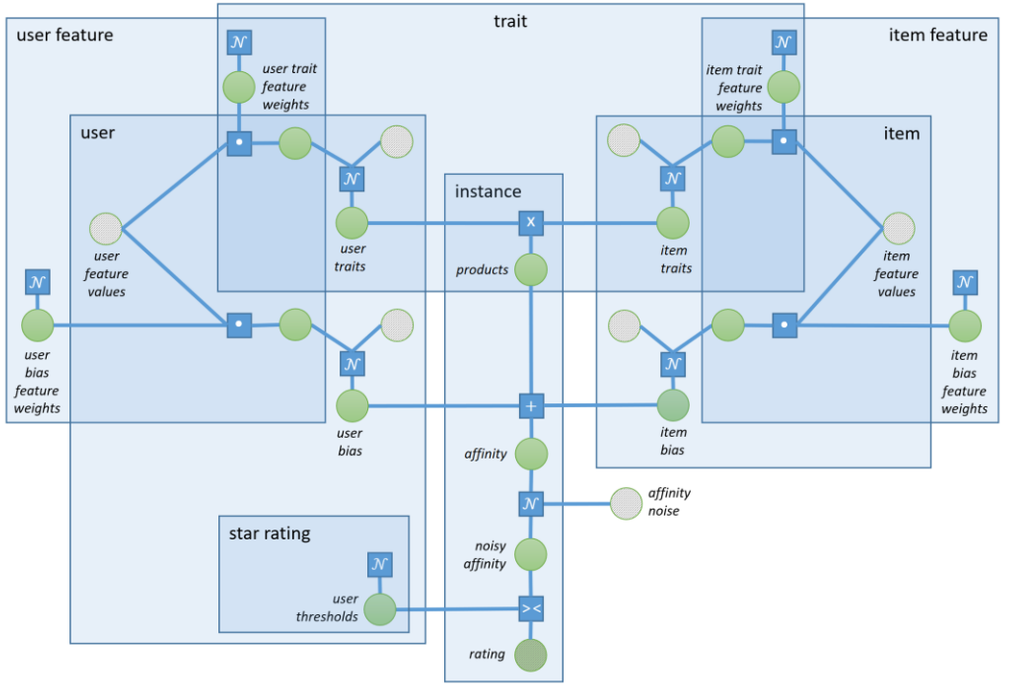
- General-purpose recommender

  Combines collaborative and content-based filtering in a single coherent model
- Initially shipped in Xbox Live

  Recommend movies and games

  Offline and online phase
- Later shipped in Azure ML

  Module that can be deployed as a web service



Alexandria

Automatic knowledge base construction

Bing

- **Inference over strings**

  Generative model for converting knowledge base facts into unstructured text

- **Automatic retrieval from the web**

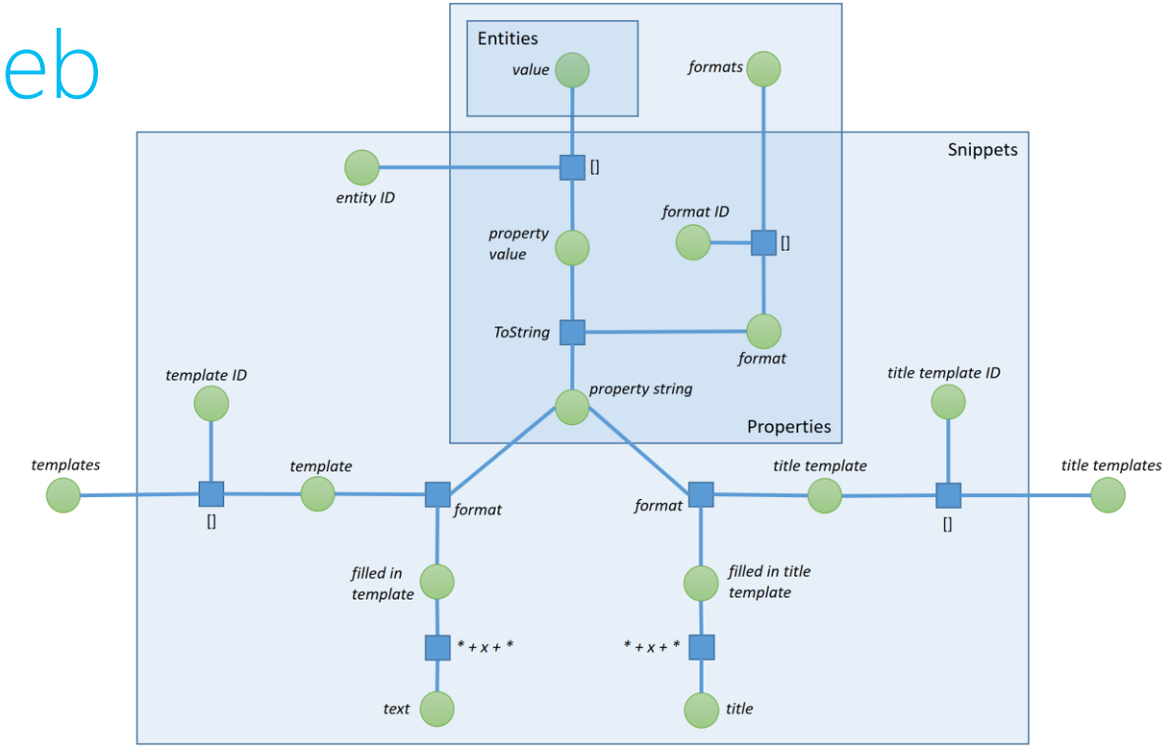
  Facts, entities, and attribute schemas

- **High precision and coverage**

  Text uncertainty propagation through to retrieved facts

- **Internet scale**

  Processing billions of web documents comprising petabytes of text data



Infer.NET features enabling productization

- Online Bayesian learning
  - Fixed point iteration, same functional form of prior and posterior
- Performance and scalability
  - Compilation, efficient inference, distribution over a cluster
- Capability for rapidly exploring models
  - Automatic inference, easy model evidence computation
- Rich modelling blocks
  - Types: double, bool, int, vector/list, string; adding date and dictionary
  - Plates, power plates, stochastic gates, arrays of arrays

Hello uncertain world

```
var str1 = Variable.StringUniform();
var str2 = Variable.StringUniform();
var text = str1 + " " + str2;
text.ObservedValue = "Hello uncertain world";

var engine = new InferenceEngine();
Console.WriteLine("str1: {0}", engine.Infer(str1));
Console.WriteLine("str2: {0}", engine.Infer(str2));
```

Free online book

MBMLbook.com