Collaborative feature location in models through automatic query expansion

Human-Competitive Awards 2019
GECCO 2019

The EA locates Features (building blocks) for systematically assembling products:

Software Product Line

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Software Product Lines are very appealing

Documented real-world examples of the benefits of Software Product Lines:

- savings of $584 million in development costs
- a 2x-4x reduction in time-to-market,
- a reduction in maintenance costs of around 60%

And the list goes on and on:

- large-scale productivity gains
- increased product quality
- decreased product risk
- increased market agility
- increased customer satisfaction
- ability to effect mass customization
- more efficient use of human resources
- ability to maintain market presence
- ability to sustain unprecedented growth
However, there is a big catch!

Software Product Lines are all about reusing software **features** within a family of products.

The **entry barrier** is locating the features in the first place!

**30 years** of work by a single engineer was the estimation for locating the software features of a real-world train manufacturer* as reported in our paper *in business since 1917
Our results are human-competitive

- A human expert is one of the baselines outperformed by our approach.
- Our results have replaced solutions created by human experts in real world industries over a long period (13+ years).

(E) The result is equal to or better than the most recent human-created solution to a long-standing problem for which there has been a succession of increasingly better human-created solutions.
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- The research community keeps a **database** of successful product line adoptions and our results include **successful adoptions**.

(C) The result is equal to or better than a result that was placed into a database or archive of results maintained by an internationally recognized panel of scientific experts.
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1. A **human expert** is one of the baselines **outperformed** by our approach.
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3. The research community keeps a **database** of successful product line adoptions and **our results include successful adoptions**.
   
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4. **International organizations** have based their business on Software Product Lines since 1999.
   - Research in the field of feature location indicates that this is a **non-trivial problem**.

   (G) The result solves a problem of indisputable difficulty in its field.
Why *our* entry is the “best”

- Academic Recognition
- Industrial Success
Academic Recognition

Accepted in a leading Software Engineering Journal: *Automated Software Engineering*

One of the reviewers stated:
“Collaborative feature location (i.e., taking multiple feature descriptions as input) is **a new dimension to this problem**”

Another reviewer stated:
“The detailed explanation provided in the paper also clearly shows the need for this approach, as **the manual work would otherwise be daunting** for developers”
Arguably the most relevant forum and book for reengineering software intensive systems into software product lines.
Train Control and Management
- top-6 manufacturer of trains worldwide
- in business since 1917
- Engineers prefer to use our features instead of their own
- features located in legacy trains and applied to new trains:

**Software Features:**
- brakes
- traction
- lights
- CCTV
- batteries
- doors
- diagnostics
- AC
- PA
- coupling...

**Industrial Success**
Induction Hobs
- top European manufacturer, and top-3 world manufacturer
- their long-standing (13+ year) features replaced by our features

- Memorable statement from a BSH software engineer: “Your tool has changed my life for the better”

Induction Hob Microchip
**Software Features:**
dynamic cooking zones, user feedback, temperature control, energy boost...
also plans to extend application of our features to the software of their factory robots

At the moment, this new application is under evaluation within H2020 European funding programme

- world leader in the design and manufacture of mission-critical radio communications
- is demonstrating interest in applying our work
Why our entry is the “best”

**Academic Recognition**
- Leading software journal
- Reviewers: “new dimension” and “otherwise daunting”
- Invited to Keynote
- Invited to Springer Handbook
- Most relevant forum and book

**Industrial Success**
- Top-6 world leader manufacturer of trains (CAF)
- Top-3 world leader manufacturer of induction hobs (BSH)
- BSH factory robots: under evaluation within H2020
- World leader in mission-critical communications (Teltronic): formal interest expressed

Replaced long-standing human solutions
Life changer!
Thanks!

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