Software Engineering and AI

This survey was part of a study conducted at Microsoft Research, Redmond. Results of the study were published in ICSE 2019 (SEIP track):

[Software Engineering for Machine Learning: A Case Study](#) Saleema Amershi, Andrew Begel, Christian Bird, Rob DeLine, Harald Gall, Ece Kamar, Nachiappan Nagappan, Besmira Nushi, Thomas Zimmermann

In this survey, we use the term "AI" broadly to refer to any form of artificial intelligence, machine learning, or statistical modeling. We use the phrase "working with AI" to mean working on any aspect of a product, feature, or service that has an AI component, including software engineering and development of the product or feature, data science or AI-component development, project management of the product or feature.

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1) What best describes your primary work area?

Data & Applied Science.
Example job titles: Applied Scientist, Data Scientist, Data Scientist Lead, Applied Science Mgr, etc.

Program Management.
Example job titles: Program Manager, Program Manager Lead, PM Manager, etc.

Research.
Example job titles: Researcher, Lead Researcher, Research Manager, etc.

Software Engineering.
Example job titles: Software Engineer, SDE, Software Engineering Mgr, etc.

Other:

3) Do you have any direct reports?

Yes

No

4) How many people do you work with on a regular basis on AI projects (approximately)?

No one (I don't need to coordinate my work)

1-2 people

3-5 people

6-14 people

15-29 people

30 or more people

5) How many projects do you work on right now?

How many AI projects do you work on right now?

6) How many years of work experience do you have? (decimals okay) Include any experience outside the current company.

7) How many years have you been working with AI? (decimals okay) Include any experience outside the current company.

On how many teams, including your current team, have you been that worked with AI? Include any teams outside the current company.

8) How many years has your current team been working with AI? (decimals okay)

9) Where have you acquired your core AI skills and knowledge? Select all that apply.

Formal education (e.g., BSc, MSc, PhD).

Internal training programs.

On the job (e.g., by building AI products).

Online materials (e.g., Coursera, Edx, Udacity, YouTube).

Self-taught.

Other:

AI in your product, feature, or service

What type of AI-based product, feature, or service do you work on? Select all that apply.

Assistants/Agents (e.g., Cortana)

Automation (e.g., semi-autonomous or autonomous cars, drones)

Business intelligence

Content creation or transformation (e.g., automatic writing, image generation, layout suggestions)

Conversational systems (e.g., bots)

Data exploration (e.g., clustering in data for sensemaking, insight generation, research)

Decision support (e.g., diagnoses, lending)

Detection (e.g., fraud or security, bias, emotion, spelling errors)

Filters (e.g., spam or news filters)

Information retrieval (e.g., search)

Object detection or recognition (e.g., OCR, face detection)

Optimization

Planning

Prediction (e.g., predictive maintenance, forecasting, now-casting)

Ranking or prioritization (e.g., search results)

Recognition (e.g., voice, activity, handwriting)

Recommendations or suggestions (e.g., ads, products, code, customers, spelling)

Robotics

Simulated characters in games (e.g., NPC characters, adaptive racing partners in Forza)

Summarization (e.g., text)

Translation

Vision (e.g., processing or analyzing images or video)

Other - Write In:

10) What is the primary use case for the AI portion of your AI-based product, feature, or service? Select all that apply.

Conversational agents (e.g., assistants, bots, Cortana)

Robotics (e.g., drones, semi-autonomous cars)

Search

Decision support and optimization (e.g., forecasting, diagnoses, resource management)

Business intelligence

Ambient intelligence (e.g., security, in store detection)

Gaming

Augmented reality or virtual reality (e.g., HoloLens, Kinect)

Productivity support (e.g., office intelligence features, code prediction)

Recommendations and advertising

Customer support

AI tools and services (e.g., Cognitive Services, TLC, AzureML)

Other:

11) Please briefly describe your AI-based product, feature, or service in a few sentences.

Does your product, feature, or service *incorporate AI as part of its user experience or interface*, that is, the output of the AI is visible to your customers?

Yes

No

Does your product, feature, or service *use AI "behind the scenes"*, where customers do not interact with the AI (for example, business intelligence)?

Yes

No

12) How effectively does your team work with AI on a scale from 1 (poor) to 5 (excellent)?

1 – Poor   2   3   4   5 – Excellent Don't know

13) What challenges do you and your team face when working with AI?

14) What is the source of the AI components (i.e., models such as classifiers or recognizers) for your product, feature, or service? Select all that apply

We build *custom* AI components in *my team*.

We use *custom* AI components built by *another team at Microsoft*.

We use *custom* AI components built by *a third party* outside Microsoft.

We use *pre-trained* AI components developed by *Microsoft* (e.g., Cognitive Services).

We use *pre-trained* AI components developed by *a third party* outside Microsoft.

Other:

Activities

15) We are interested in how many hours per week you typically spend doing the following AI-related activities. In this survey, we ask about these activities individually, with the understanding that they are often done together and with frequent backtracking and iterations. Please estimate hours per week. Decimals are okay.

Include any AI-related activity we have not asked about in "Other activities related to AI" at the end of the list.

Model requirements and design. [What is this? The earliest stage in creating a model or AI, which involves understanding customer needs, conceiving of models or AIs that could help address those needs, and early feasibility testing.]

Data collection. [What is this? Finding existing data needed for model training, or updating pipelines to collect new data.]

Data cleaning. [What is this? Transforming data from the format in which it is collected into the required format and possibly improving the quality of the data.]

Data labeling. [What is this? Adding additional information to the collected data, typically requiring human judgment, for example adding a category that is used to train a classifier.]

Feature engineering. [What is this? Choosing the data attributes to be used for building a model, which could involve computing new attributes derived from the original data attributes.]

Model training and tuning. [What is this? Running a machine learning algorithm over the data features including choosing good values for any additional parameters the algorithm requires.]

Model evaluation. [What is this? Computing statistics about how well the model performs its intended task in offline benchmark datasets, such as the rate of false positives and false negatives in classifying real-world data.]

Model integration and deployment. [What is this? Integrating a model in a bigger system and putting it into a production environment, including any necessary additional work on integration testing and system engineering (e.g., to communicate with other components in the product, to support continuous learning)]

Model monitoring. [What is this? Analyzing ongoing information about the model after deployment including its performance changes and customer feedback.]

Other activities related to AI. (Please describe the activity in the next question.)

16) If there are any important activities in your job related to AI that we missed in the previous question, please enter them here.

17) How many hours per week do you typically spend on the following cross-cutting activities. (decimals okay)

Management activities related to AI. [What is this? For example, coordinating efforts across activities and team members, managing dependencies with external partners, etc.]:

Documentation and model management. [What is this? For example, keeping track of model building activities including data, model and code versioning, and experiments run.]:

Debugging of AI models and systems. [What is this? For example, understanding, diagnosing and fixing errors in learning models and the system as a whole.]:

Education/learning/training related to AI. [What is this? For example, keeping up with new algorithms and technologies, reading research papers, taking classes etc.]:

Scheduled meetings related to AI.

Activities

Note: Participants here were asked only about the two activities that they spent most time on.

18) We will now ask a few questions about

Model requirements and design.

This activity refers to the earliest stage in creating a model or AI, which involves understanding customer needs, conceiving of models or AIs that could help address those needs, and early feasibility testing.

How effective do you think your *team's practices* around model requirements and design are on a scale from 1 (poor) to 5 (excellent)?

1 – Poor   2   3   4   5 – Excellent   Don't know

Please rate your agreement with the following statements about how your team does the model requirements and design activity.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
My team has **goals defined** for what to accomplish with this activity.						
My team does this activity in **consistent manner**.						
My team has largely **documented** the practices related to this activity.						

My team does this activity mostly in an **automated way**.					
My team **measures/tracks** how effective we are at completing this activity.					
My team **continuously improves** our practices related to this activity.					

What tools do you and your team commonly use in the model requirements and design activity?

Please explain in a few sentences how you and your team do the model requirements and design activity (e.g., common practices, formal or informal processes).

What challenges do you and your team face during the model requirements and design activity?

19) We will now ask a few questions about

Data collection.

This activity refers to finding existing data needed for model training, or updating data pipelines to collect new data.

How effective do you think your *team's practices* around data collection are on a scale from 1 (poor) to 5 (excellent)?

1 – Poor   2   3   4   5 – Excellent   Don't know

Please rate your agreement with the following statements about how your team does the data collection activity.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
My team has **goals defined** for what to accomplish with this activity.						
My team does this activity in **consistent manner**.						
My team has largely **documented** the practices related to this activity.						
My team does this activity mostly in an **automated way**.						
My team **measures/tracks** how effective we are at completing this activity.						
My team **continuously improves** our practices related to this activity.						

What tools do you and your team commonly use in the data collection activity?

Please explain in a few sentences how you and your team do the data collection activity (e.g., common practices, formal or informal processes).

What challenges do you and your team face during the data collection activity?

20) We will now ask a few questions about

Data cleaning.

This activity refers to transforming data from the format in which it is collected into the required format and possibly improving the data's quality.

How effective do you think your *team's practices* around data cleaning are on a scale from 1 (poor) to 5 (excellent)?

1 – Poor   2   3   4   5 – Excellent   Don't know

Please rate your agreement with the following statements about how your team does the data cleaning activity.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
My team has **goals defined** for what to accomplish with this activity.						
My team does this activity in **consistent manner**.						
My team has largely **documented** the practices						

related to this activity.					
My team does this activity mostly in an **automated way**.					
My team **measures/tracks** how effective we are at completing this activity.					
My team **continuously improves** our practices related to this activity.					

What tools do you and your team commonly use in the data cleaning activity?

Please explain in a few sentences how you and your team do the data cleaning activity (e.g., common practices, formal or informal processes).

What challenges do you and your team face during the data cleaning activity?

21) We will now ask a few questions about

Data labeling.

This activity refers to adding additional information to the collected data, typically requiring human judgment, for example adding a category that is used to train a classifier.

How effective do you think your *team's practices* around data labeling are on a scale from 1 (poor) to 5 (excellent)?

1 – Poor   2   3   4   5 – Excellent Don't know

Please rate your agreement with the following statements about how your team does the data labeling activity.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
My team has **goals defined** for what to accomplish with this activity.						
My team does this activity in **consistent manner**.						
My team has largely **documented** the practices related to this activity.						
My team does this activity mostly in an **automated way**.						
My team **measures/tracks** how effective we are at completing this activity.						
My team **continuously improves** our						

practices related to this activity.						

What tools do you and your team commonly use in the data labeling activity?

Please explain in a few sentences how you and your team do the data labeling activity (e.g., common practices, formal or informal processes).

What challenges do you and your team face during the data labeling activity?

22) We will now ask a few questions about

Feature engineering.

This activity refers to choosing the data attributes to be used for building a model, which could involve computing new attributes derived from the original data attributes.

How effective do you think your *team's practices* around feature engineering are on a scale from 1 (poor) to 5 (excellent)?

1 – Poor   2   3   4   5 – Excellent   Don't know

Please rate your agreement with the following statements about how your team does the feature engineering activity.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
My team has **goals defined** for what to accomplish with this activity.						
My team does this activity in						

consistent manner.						
My team has largely **documented** the practices related to this activity.						
My team does this activity mostly in an **automated way**.						
My team **measures/tracks** how effective we are at completing this activity.						
My team **continuously improves** our practices related to this activity.						

What tools do you and your team commonly use in the feature engineering activity?

Please explain in a few sentences how you and your team do the feature engineering activity (e.g., common practices, formal or informal processes).

What challenges do you and your team face during the feature engineering activity?

23) We will now ask a few questions about

Model training and tuning.

This activity refers to running a machine learning algorithm over the data features, including choosing good values for any additional parameters the algorithm requires.

How effective do you think your *team's practices* around model training and tuning are on a scale from 1 (poor) to 5 (excellent)?

1 – Poor   2   3   4   5 – Excellent   Don't know

Please rate your agreement with the following statements about how your team does the model training and tuning activity.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
My team has **goals defined** for what to accomplish with this activity.						
My team does this activity in **consistent manner**.						
My team has largely **documented** the practices related to this activity.						
My team does this activity mostly in an **automated way**.						
My team **measures/trac**						

ks how effective we are at completing this activity.					
My team **continuously improves** our practices related to this activity.					

What tools do you and your team commonly use in the model training and tuning activity?

Please explain in a few sentences how you and your team do the model training and tuning activity (e.g., common practices, formal or informal processes).

What challenges do you and your team face during the model training and tuning activity?

24) We will now ask a few questions about

Model evaluation.

This activity refers to computing statistics about how well the model performs its intended task in offline benchmark datasets, such as the rate of false positives and false negatives in classifying real-world data.

How effective do you think your *team's practices* around model evaluation are on a scale from 1 (poor) to 5 (excellent)?

1 – Poor   2   3   4   5 – Excellent   Don't know

Please rate your agreement with the following statements about how your team does the model evaluation activity.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable

My team has **goals defined** for what to accomplish with this activity.					
My team does this activity in **consistent manner**.					
My team has largely **documented** the practices related to this activity.					
My team does this activity mostly in an **automated way**.					
My team **measures/tracks** how effective we are at completing this activity.					
My team **continuously improves** our practices related to this activity.					

What tools do you and your team commonly use in the model evaluation activity?

Please explain in a few sentences how you and your team do the model evaluation activity (e.g., common practices, formal or informal processes).

What challenges do you and your team face during the model evaluation activity?

25) We will now ask a few questions about

Model integration and deployment.

This activity refers to integrating a model in a bigger system and putting it into a production environment, including any necessary additional work on integration testing and system engineering (e.g., to communicate with other components in the product, to support continuous learning from user feedback).

How effective do you think your *team's practices* around model integration and deployment are on a scale from 1 (poor) to 5 (excellent)?

1 – Poor   2   3   4   5 – Excellent   Don't know

Please rate your agreement with the following statements about how your team does the model integration and deployment activity.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
My team has **goals defined** for what to accomplish with this activity.						
My team does this activity in **consistent manner**.						
My team has largely **documented** the practices related to this activity.						

My team does this activity mostly in an **automated way**.						
My team **measures/tracks** how effective we are at completing this activity.						
My team **continuously improves** our practices related to this activity.						

What tools do you and your team commonly use in the model integration and deployment activity?

Please explain in a few sentences how you and your team do the model integration and deployment activity (e.g., common practices, formal or informal processes).

What challenges do you and your team face during the model integration and deployment activity?

26) We will now ask a few questions about

Model monitoring.

This activity refers to analyzing ongoing information about the model after deployment, including its performance changes and customer feedback.

How effective do you think your *team's practices* around model monitoring are on a scale from 1 (poor) to 5 (excellent)?

1 – Poor   2   3   4   5 – Excellent Don't know

Please rate your agreement with the following statements about how your team does the model monitoring activity.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
My team has **goals defined** for what to accomplish with this activity.						
My team does this activity in **consistent manner**.						
My team has largely **documented** the practices related to this activity.						
My team does this activity mostly in an **automated way**.						
My team **measures/tracks** how effective we are at completing this activity.						
My team **continuously improves** our practices related to this activity.						

What tools do you and your team commonly use in the model monitoring activity?

Please explain in a few sentences how you and your team do the model monitoring activity (e.g., common practices, formal or informal processes).

What challenges do you and your team face during the model monitoring activity?

Almost done!

27) What dream tool would help make you or your team better at working with AI?

28) What AI practices does your team follow that you think other teams might want to know about?

29) If you have any other comments regarding software engineering and AI or this this survey in general, please enter them here.

We are still improving this survey and want to make sure that this survey is useful and clear. If any questions were unclear to you or there are any changes that you would make, please share your feedback with. Thank you for helping us to improve this survey!

Thank You!