Software Bots in Software Engineering
Benefits and Challenges

Mairieli Wessel, Marco Gerosa, and Emad Shihab
What is a bot?
What is a bot?

A bot is an agent of automation.

A bot can perform automated, repetitive, predefined tasks. Some bots can intelligently adapt their behavior.

From answering questions, to automatically deploying application, bots can serve a variety of purposes.
How have bots been described?

GitHub bots

may need to sign the corporate CLA.

Once the CLA is signed, our tooling will perform checks and validations. Afterwards, the pull request will be tagged with CLA signed. The tagging process may take up to 1 hour after signing. Please give it that time before contacting us about it.

If you have received this in error or have any questions, please contact us at cla@fb.com. Thanks!

Facebook Community bot

Thank you for signing our Contributor License Agreement. We can now accept your code for this (and any) Facebook open source project. Thanks!
How have bots been described?

- Bots as automation providers
- Bots with conversational skills
- Bots with human-like behaviors
- Bots as an interface between users and services

Chatbots

ELIZA, 1966

Mica, 2016
How have bots been described?

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Where do bots live?
Which of the four types of bots have you encountered?

- Bots as automation providers
- Bots with conversational skills
- Bots with human-like behaviors
- Bots as an interface between users and services
Pull Request Review Process

Submit pull request

Code Review

Discussions

Merged pull request

Code Updates

Contributor

Project Maintainer

Bot automation
Facebook Community Bot
facebook-github-bot

Popular repositories

facebook-github-bot doesn't have any public repositories yet.

5,244 contributions in the last year

Contribution activity

October 2018

- Created 7 commits in 2 repositories
  - WhatsApp/WADebug 6 commits
  - facebook/facebook-nodedis:business-cdk 1 commit

- Reviewed 728 pull requests in 40 repositories
[react-is] add back proper AsyncMode symbol, for back compat #13959

I'm Open wants to merge 1 commit into facebook:master from jjhart:react-is-async-mode

 commented 4 days ago

- Partial revert of #13732
- Fixes #13956.

I didn't add tests for isAsyncMode because #13732 didn't preserve any - happy to add them if needed.

facebook-github-bot added the CLA Signed label 4 days ago

just referenced this pull request 4 days ago

react-is breaking change, re AsyncMode #13958
facebook-github... commented 5 days ago

Thank you for your pull request and welcome to our community. We require contributors to sign our Contributor License Agreement, and we don’t seem to have you on file. In order for us to review and merge your code, please sign up at https://code.facebook.com/cla. If you are contributing on behalf of someone else (e.g., your employer), the individual CLA may not be sufficient and your employer may need the corporate CLA signed.

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Bots are spread across all pull request workflow
Dependency Management Bots
Coverage

Bots
Welcoming Bots

new Issue from new user! #7

hiimbex-test commented 24 days ago

my first issue!

new-issue-welcome bot commented 24 days ago

This is a template for greeting new users when they open their first issue in your repository. You can use this welcome message to provide links to resources like the contributing guidelines, code of conduct, etc.
Repository Management Bots
Categories of studies

- Bot-specific studies
- Empirical studies
- Tools and infrastructure
Technical debt management bot (Bot-specific study 🤖)

**Human interaction vs. Bot interactions** *(Empirical study)*

<table>
<thead>
<tr>
<th>Objective</th>
<th>Approach</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigate how maintainers interact with pull requests created automatically by bots</td>
<td>GitHub Bots detection</td>
<td>One third of all pull requests on GitHub originate from bots</td>
</tr>
<tr>
<td>Data analysis</td>
<td>Low acceptance rate and longer processing times of bot pull requests</td>
<td></td>
</tr>
</tbody>
</table>

Sankie bots infrastructure
(Tools and Infrastructure)

Sankie overview.

Benefits
What are the benefits of using software bots in a software project?
Who benefits from the use of software bots in software engineering?

- Project developers/maintainers
- Newcomers
- Students
- None of the above

When poll is active, respond at pollev.com/marcogerosa517
Text MARCOGEROSA517 to 37607 once to join
Maintainers

Students

Newcomers
Benefits of using software bots

Reasons for adopting a Code Review bot

- Enhance feedback to developers
- Reduce maintainers effort
- Enforce high code coverage
- Ensure high-quality standards
- Automate routine tasks

Supporting newcomers

James Dominic et al. "Conversational bot for newcomers onboarding to open source projects”. In: BotSE 2020
Supporting SE students

Activities

Increase after bot adoption

# Merged Pull Requests

Decrease after bot adoption

# Non-merged Pull Requests

# Comments on Merged Pull Requests

Time-to-close Pull Requests

Developers’ Perspective

- Changes in developers’ discussion focus
- Pushes contributors to take an action
- More visibility and transparency
- More confidence in the process in place
- Bot feedback perceived as noise

Challenges
What are the challenges of software bots?
General Challenges
General Challenges ⇚ Research Gaps

**Interfaces**
- ASR
- Text vs. voice

**Interaction**
- Flexible Dialogue Management (> rules)

**Trust**
- Explainability
- Responsibility

Interaction Challenges

- General Challenges
- Interaction Challenges
- Development Challenges
  - Noise
  - Expectation Breakdowns
  - Ethical Issues
Interaction Challenges

Noise
- Verbosity & Frequency
- Unsolicited Actions

Expectation breakdowns
- Intimidating newcomers
- Strange interactions

Ethical issues
- Impersonating developers
- Malicious intent

<table>
<thead>
<tr>
<th>Issue</th>
<th>Title</th>
<th>Type</th>
<th>Changes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#9708</td>
<td>Bump checkstyle from 8.45 to 8.46.1</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9707</td>
<td>Bump jaxb-runtime from 2.3.2 to 3.0.2</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9706</td>
<td>Bump jaxb-xml: from 2.3.3 to 3.0.2</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9705</td>
<td>Bump classpath from 4.8.110 to 4.8.112</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9704</td>
<td>Bump byte-buddy-parent from 1.11.9 to 1.11.12</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9703</td>
<td>Bump WyvixMaximus/github-action-wait-for-status from 1.3 to 1.4</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9702</td>
<td>Bump commons-csv from 1.8 to 1.9.0</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9701</td>
<td>Bump floxless from 0.6.4 to 0.6.5</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9700</td>
<td>Bump style/cancel-workflow-action from 0.9.0 to 0.9.1</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9699</td>
<td>Bump checkstyle from 0.44.0 to 0.45</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9698</td>
<td>Bump byte-buddy-parent from 1.11.8 to 1.11.9</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9697</td>
<td>Bump inkscape-unicode from 2.1.2 from 0.2.6 to 0.2.7</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9696</td>
<td>Bump unloader from 7.1.4 to 7.1.5</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9695</td>
<td>Bump libfreecode from 7.1.4 to 7.1.5</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9694</td>
<td>Bump org.uberj.jlink from 2.2.0 to 2.2.1</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9693</td>
<td>Bump archunit-junit5-ai from 0.20.0 to 0.20.1</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9692</td>
<td>Bump archunit-junit5-engine from 0.20.0 to 0.20.1</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#9691</td>
<td>Bump unicode-java from 3.11.11 to 3.11.12</td>
<td>dependencies</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

High frequency

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Expectations breakdowns & Ethical issues
Development Challenges
Development Challenges

Integration

Messenger & NLU integration

NLUs & Model Training

Defining intents & entities

User Interaction

Response time

User interface

Messenger and NLU integration

how to integrate bot into skype

Microsoft Bot Framework integration with Slack is broken

Connect a bot to Microsoft Teams

APPLIES TO: SDK v4

You can configure your bot to communicate with people via Microsoft Teams. This article describes how to create a Teams app in Teams, connect your bot to your Teams app in Azure, and then test your bot in Teams.
Defining intents and entities

How To Solve The Double Intent Issue For Chatbots

Can't figure out how to add Follow up Intents in my bot

Two different intents with the same training phrases - DialogFlow. How to ensure both intents get used

Many similar intents in multiple scenes

Hello everyone, because there are many scenes, there are many different keywords and entities in the context between scenes. The text of each sentence is also blurred which leads to confusion in the
Defining intents and entities

Hey guys, is the master branch failing on your end? There appears to be a problem in the /src/component/home.ts file.

I suggest you look at #4320, this has been marked as a bug in the past. In the meantime, use the dev branch.
Response time

How fast should a chat-bot respond?

Chen Levkovich, Co-founder and CEO at Conversation.one (2017–present)
Answered Jun 30, 2017

To mimic a human response, a bot should answer quickly to a simple question, and do some “thinking” on a heavy one.
Chatbot topics popularity vs. difficulty
Challenges in Bot Development

65% of developers work **alone** when developing bots

95% developed by **groups** of 2 or less

Challenges for researchers

Identifying bots

BotHunter: An Approach to Detect Software Bots in GitHub
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ABSTRACT
Bots have become popular in software projects as they play critical roles in many areas. However, the number of bot accounts is growing rapidly. In this paper, we propose BotHunter, a machine learning-based approach to detect bots in GitHub. BotHunter uses a combination of features to identify bot accounts. We evaluated BotHunter on a dataset of 5,000 bot accounts and 5,000 human accounts. BotHunter achieved an accuracy of 92%, which is significantly higher than existing methods. We believe that BotHunter will be useful for researchers who study bot behavior and for developers who want to better understand the impact of bots on their projects.

A ground-truth dataset and classification model for detecting bots in GitHub issue and PR comments
Mehdi Colzadegi*, Alexandre Decan, Damien Legay, Tom Mens
Software Engineering Lab, University of Nantes, Avenue de la Manche 25, 44000 Nantes, France

ABSTRACT
Bots are frequently used in GitHub repositories to automate repetitive tasks that are part of the development process. Detecting them is important to protect the integrity of the repository. We have developed a classification model that can detect bots in GitHub issue and pull request comments. This model achieved an accuracy of 89%, which is significantly higher than existing methods. We believe that this model will be useful for researchers who study bot behavior and for developers who want to better understand the impact of bots on their projects.
The community

➔ International Workshop on Bots in Software Engineering (BotSE.org)

➔ Where to publish (everywhere - ICSE, FSE, MSR, ICSME, SANER, CSCW, etc.)

➔ Repository for Bot-related research (papers.botse.org)
Creating a real bot

https://github.com/mairieli/bot-tutorial
1. Register it on GitHub
2. Create a GitHub Bot
3. Install it on repos
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