explaining the world of bits and behavior

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use group

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the 2010 Toyota Prius
Consumption

= 50 Wh Regenerated

Energy

Average 99.9 MPG

1035 miles

Friday, May 11, 12
Prius owners stay loyal thru all problems...

I'M TIRED OF ALL THE NEGATIVE THINGS.
I STILL LOVE MY PRIUS, DO YOU?
PLEASE READ LINK:
Most Prius owners stay loyal despite recalls - Autos- msnbc.com

LOOK AT ME! I DRIVE A PRIUS.

I'M DESTROYING THE PLANET SLOWER THAN YOU ARE.
February 5th, 2010, CNN
U.S. Starts Inquiry Into Brake Problems on Prius

By NICK BUNKLEY
Published: February 4, 2010

DETOUR — No sooner had Toyota dealerships begun to repair accelerator pedals on millions of recalled vehicles than the carmaker said it was considering yet another major recall, this time for problems with the brakes on its Prius hybrid.

Safety regulators in Washington said Thursday that they would open an investigation into the brakes on the 2010 Prius, which had been spared from the recall lists.

The announcement was made hours after Toyota acknowledged that it had identified a flaw in the car’s anti-lock braking system and corrected it for Priuses built since late January. The car was redesigned for the 2010 model year.

Prius drivers have complained that the car momentarily
"... we're writing these things that we can no longer read. And we've rendered something illegible, and we've lost the sense of what's actually happening in this world that we've made."
function compute(x, y)
  if (x >= 0)
    if (y >= 0) print x/y
    else print y/x
  else
    if (y >= 0) print x/y
    else print y/x

how many ways can this code execute?
software complexity is a source of both power and confusion
why did the stock market crash May 6th, 2010?

The plane, an Airbus A330, carrying 303 passengers and 12 crew, twice nosedived after flight computers went haywire, leaving 110 passengers and nine crew members injured as they were flung about the cabin, hitting overhead lockers and fittings.

Investigators found fault with the way the algorithm had been written in the early 1990s that translated the sensors' data into actions, where the flight control computer could put the plane into a nosedive using bad data from just one sensor.
“What can my friends see?”

NY Times, 5/12/10

how can we help people better understand our increasingly software-based world?
software should explain itself

Word, why do you keep crashing????

I didn’t think documents would ever get this big!
ask **why** and the software explains itself
Whyline Alice
for learners

Whyline Java
for developers

Crystal
for users

ask **why** and the software explains itself
three new approaches to software explaining itself
compilers are framed as authoritative, all knowing **adversaries**

they call beginner’s first efforts “invalid”
what if computers were instead framed as the **helpless, ignorant, but eager collaborators** they actually are?

would beginners **empathize** with them and be more motivated to help them?

would they learn to communicate with (program) a computer more effectively?
Gidget is a robot that can write programs that accomplish his goals.

Gidget is sent to clean up a chemical spill and you’re supposed to monitor progress.

Gidget confides in you that he makes a lot of mistakes and has no idea how to fix them.

It’s up to the player to help Gidget fix his programs by paying close attention to Gidget’s interpretation of each command.

I looked for cat to grab, but didn’t find anything.
My power levels are still fluctuating and I don't have enough energy to clean up the goops in this area!
over 500 people have played the game (via studies)

"Never learned about programming. It's challenging and fun!"

"I had no experience with programming. I learned some programming in high school but it was very basic very short and very long time ago. This experience was much more entertaining."

"This is really awesome concept. As I did not have any previous experience in programming, I just fell in love with this one!"

"It did not even seem like I was learning programming. It truly felt like I was just playing a game. I tend to become frustrated easily yet this held my attention and made it so I didn't want to give up."

"Sometimes it was more fun than a normal class because it was like a puzzle and you had visual elements to help you get it right."
1) giving the computer a face and
2) having it use personal pronouns
daffect motivation to play?

VS.

face + personal pronouns
terminal + conventional errors
does
recruited via Mechanical Turk

30 cents for completing starting the game and completing the first level.

10 cents for each additional level completed

did not to mention anything about programming in our task description

excluded participants who had taken a course or written a program

116 novices recruited
58 in each condition
50 females, 66 males
mean age 28 years (18-57)
participants could quit at any time

measure of motivation was levels voluntarily completed
people who played with 🎮 completed significantly more levels

control completed a median of 2
experimental completed a median of 5
no difference in how long people played

control 27 minutes vs. experimental 35 minutes (n.s.)

no difference in frequency of executions

no difference in type of executions

except control group used “execute to next line” more frequently, skipping over Gidget’s interpretation of each command
no differences in enjoyment

“I enjoyed playing the game” (n.s.)

“I would recommend this game to a friend wanting to learn programming (n.s.)

except

“I wanted to help Gidget succeed” (p < .01)
what explains the differences?

players who played with  🌡️  played just as long, but paid closer attention to  🌡️  ‘s explanations of how he was interpreting each command.

this is likely why players in the experimental group completed more levels in the same amount of time
framing computers as collaborators may compel people to attend more closely to explanations of its behavior
all over the web, apps are ignoring people, failing to explain how they processed input
all over the web, apps are ignoring people, failing to explain how they processed input

where’s the feedback?
web apps are full of flaws like these

if(everything is normal) {
  provideFeedback();
} else {} // TODO

and the TODO is rarely done
code like this is a violation of a foundational principle of HCI

FOR EVERY INPUT, THERE SHOULD BE AN OUTPUT EXPLAINING HOW THE INPUT WAS USED

(there should always be feedback)
FeedLack verifies that all control flow paths originating from user input produce output for example...
for example...

```html
<form id='form' onsubmit="post(form.comment.value)">
  <input id='comment' type='text' />
  <input onclick=post(form.comment.value)>
</form>
```

here's a form that posts the value of a comment field when **enter** is typed or **submit** is clicked.
for example...

```javascript
function post(text) {
  if (isValid(text)) {
    $.get("comment.php", { comment: text });
  } else {
    alert("Your comment is invalid.");
  }
}
```

when `post()` is called, the comment is posted if valid; otherwise, an alert is shown.
isValid() provides feedback on empty comments.

```javascript
function post(text) {
    if(isValid(text))
        $.get("comment.php", { comment: text });
    else
        alert("Your comment is invalid.");
}

function isValid(comment) {
    if(comment == '')
        $('#comment').text('write something!');
    return comment != '';
}
```
FeedLack

for example...

```html
<form id='form' onsubmit="post(form.comment.value)">
    <input id='comment' type='text' />
    <input onclick=post(form.comment.value) />
</form>

<script type='text/javascript'>
    function post(text) {
        if(isValid(text))
            $.get("comment.php", { comment: text });
        else
            alert("Your comment is invalid.");
    }
    function isValid(comment) {
        if(comment == '')
            $('#comment').text('write something!');
        return comment != '';
    }
</script>

what's wrong?
post(text) at index.html

When the user performs a

- submit (index.html 21), or
- click (index.html 23)

this path may fail to produce output:

1. post() is entered index.html 9
   assumes this function can produce output because alert() can
   produce output

2. isValid() is called index.html 10
   assumes this calls isValid(comment), because no other functions by
   this name were found

3. isValid() is entered index.html 5
   assumes this function can produce output because text() can
   produce output

4. the expression at index.html 4 is false

5. the expression at index.html 10 is true
   assumes condition can be true

6. several functions are called that do not affect output
   assumes get() (not found) does not affect output

7. post() is exited index.html 16 without producing output

Friday, May 11, 12
FeedLack found to events handlers that invoke the same function

When the user performs a

- submit(index.html) or
- click(index.html)

this path may fail to produce output:

1. post() is entered index.html
2. isVaid() is entered index.html
3. isValid() is entered index.html
4. the expression at index.html is false
5. the expression at index.html is true
6. several functions are called that do not affect output
7. post() is exited index.html without producing output

<form id='form' onsubmit="post(form.comment.value)">
<input id='comment' type='text' />
<input onclick=post(form.comment.value) />
</form>

<script type='text/javascript'>
function post(text) {
  if(isValid(text))
    $.get("comment.php",
    else
      alert("Your comment
      function isValid(comment)
      if(comment == '')
        $('#comment').text(
          return comment != '';
      }
</script>
post (text) at index.html

When the user performs a

• submit (index.html 21), or
• click (index.html 23)

this path may fail to produce output:

1. post() is entered index.html 9
   assumes this function can produce output because alert() can
   produce output

2. isValid() is called index.html 10
   assumes this calls isValid(comment), because no other functions by
   this name were found

3. isValid(comment) is called index.html 9
   assumes this function can produce output because text() can
   produce output

4. the expression at index.html 4 is false

5. the expression at index.html 10 is true
   assumes condition can be true

6. several functions are called that do not affect output
   assumes alert() (not found) does not affect output

7. post() is exited index.html 16 without producing output

post() handles the input

function post (text) {
  if (isValid (text))
    $.get("comment.php")
  else
    alert("Your comment

    function isValid (comment) {
      if (comment == ")
        $('#comment').text(
          return comment != ");
    }

</script>
2. isValid() is called **index.html**
   - assumes this calls isValid(comment), because no other functions by this name were found

isValid() might affect input...

4. the expression in **index.html** is false
5. the expression in **index.html** is false
6. several functions are called that do not affect output

When the user performs a
  - submit(index.html 21).
  - click(index.html 23)

this path may fail to produce output:

1. post() is entered **index.html**
   - assumes this function can produce output because alert() can produce output

function post(text) {
  if(isValid(text))
    $.get("comment.php"
   else
    alert("Your comment

    function isValid(comment) {
      if(comment == '')
        $('#comment').text(
          return comment != '';

</script>
isValid() has to be entered to affect input
if the comment is not empty, it will skip output
if the comment is valid (which it will be, given the previous condition)

```javascript
if (isValid(comment))
    $.get("comment.php",
        function (result) {
            // Process the result
        });
    if (result == "success")
        alert("Your comment has been posted.");
else
    alert("Your comment is invalid.");
```

5. the expression at `index.html:10` is **true**

6. several functions are called that do not affect output
   assumes `get()` (not found) does not affect output
7. `post()` is exited `index.html:13` without producing output
and assuming $.get() produces no output...

1. `post()` is entered `index.html` and assumes this function can produce output because `alert()` can.
2. `isValid()` is called `index.html` 6 and assumes this function can produce output because `text()` can produce output.
3. `isValid()` is entered `index.html` 5 and assumes this function can produce output because `text()` can produce output.
4. The expression at `index.html` 4 is false.
5. The expression at `index.html` 10 is true and assumes condition can be true.
6. Several functions are called that do not affect output.
   Assumes `get()` (not found) does not affect output.
7. `post()` is exited `index.html` 14 without producing output.
the input handler will exit without producing feedback

1. post() is entered index.html
   assumes this function can produce output because alert() can produce output
2. isValid() is called index.html
   assumes condition can be true
3. isValid() is entered index.html
   assumes condition can be true
4. isValid() is exited index.html
   assumes condition is false
5. the expression at index.html is true
6. several functions are called that do not affect output
   assumes get() (not found) does not affect output
7. post() is exited index.html without producing output
post(text) at index.html

When the user performs a
• submit(index.html 21), or
• click(index.html 23)

this path may fail to produce output:

1. post() is entered index.html 2
   assumes this function can produce output because alert() can
   produce output
2. isValid() is called index.html 10
   assumes isValid() can produce output
3. isValid() is entered index.html 12
   assumes isValid() can produce output
4. isValid() is exited index.html 14 is false
5. the expression at index.html 10 is true
   assumes condition can be true
6. several functions are called that do not affect output
   assumes alert() (not found) does not affect output
7. post() is exited index.html 16 without producing output

the input handler will exit without producing feedback

<form id='form' onsubmit="post(form)">
  <input id='comment' type='text' />
  <input onclick=post(form comment)value />
</form>

<script type='text/javascript'>
  function post(text) {
    if(isValid(text))
      $.get("comment.php")
    else
      alert("Your comment

function isValid(comment)
  if(comment == '')
    $('#comment').text('return comment != '';

  }
</script>
The obvious solution is to add feedback on success.
The obvious solution is to add feedback on success.
implementation

ten steps

1) identifying and naming functions
2) generating function control flow graphs
3) propagating type information
4) resolving function calls
5) identifying output-affecting statements
6) identifying input-handling functions
7) enumerating paths through input handlers
8) expanding paths through input handlers
9) Identifying output-lacking paths
10) clustering output-lacking paths
implementation

9) Identifying output-lacking paths

paths lacking an output affecting statement are marked as **output lacking**
are FeedLack’s warnings legitimate?

sampled 129 web application’s client-side code

14 failed due to path explosion

33/115 applications had no warnings

the 82 remaining had 647 output-lacking paths

proportion of warning types per app
are FeedLack’s warnings legitimate?

<table>
<thead>
<tr>
<th>False Positives (30%)</th>
<th>True Positives (70%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12% infeasible paths</td>
<td>34% output-missing true positives that followed standard UI conventions</td>
</tr>
<tr>
<td>18% output-producing false positives</td>
<td>36% output-deserving true positives that violated standard UI conventions</td>
</tr>
</tbody>
</table>

- 12% infeasible paths
- 18% output-producing false positives
- 34% output-missing true positives that followed standard UI conventions
- 36% output-deserving true positives that violated standard UI conventions
how severe were the true positives?

buttons that ignored input in certain modes

text controls that ignored keystrokes

dead links

silent errors

silent success

missing hover feedback

significantly delayed asynchronous feedback
FeedLack finds situations where software seems ignores input helps developers help software better explain it's behavior through feedback
LemonAid

how do I change the default busy setting for an event to ‘busy’?

how can other people add events to my calendar?

why do I keep getting e-mails that I have nothing scheduled?

why does my calendar now print on 2 pages instead of 1?

how do I add icons to my events?

how do I remove all of these birthday events that appeared after I clicked something on Facebook?

how can my collaborators see all of the events from my multiple calendars on one page?

how do I change my primary calendar?
how do I change the default busy setting for an event to ‘busy’?

instead of **authoring** queries...

what if users **select** queries?
selections are queries, used to retrieve relevant questions and answers.

users can ask narrow search by adding keywords or ask their own questions.
how it works

every time someone asks LemonAid question, it stores a query

\{\text{selected text, XPath, and tag type}\}

new queries are scored with a weighted sum of text, path, and tag similarity against existing queries

high similarity queries (and attached answers) are retrieved and ranked based on the similarity score and presented in the user interface
created 55 help scenarios from the Google Calendar FAQ with screenshots, asking each participant to select something in the UI they thought was most relevant to the scenario for each of the resulting 2,748 queries, used LemonAid to retrieve a list of matching queries, we considered each retrieved query relevant if it corresponded to the same help scenario as the query being evaluated.

Need to explain this evaluation much better. Dan Weld was concerned that the wording of the scenarios would lead to less fragmentation. He also didn’t understand the ground truth.
90% of queries returned ≥ 1 result

median rank of 1st relevant result was 2

most of the time, users will find a relevant answer with a single click
why does it work?

people are much more likely to select the same user interface element for a problem than they are to write the same query.
enables software to answer a wide range of how and why with the click of a button
software should explain itself
Facebook Privacy: A Bewildering Tangle of Options

To manage your privacy on Facebook, you will need to navigate through 50 settings with more than 170 options. Facebook says it wants to offer precise controls for sharing on the Internet.

Related Article →

MAIN FACEBOOK ACCOUNT PAGE

WEB PAGE ON FACEBOOK

CONTACT INFORMATION phone numbers, e-mail and physical addresses

PERSONAL INFORMATION name, account, birth date, gender, and location

FRIENDS, TAGS, CONNECTIONS friends, tagging, and friends list

APPRODUCES AND WEB SITES Facebook-powered Web sites

SEARCH Facebook or public search results

BLOCK LIST Blocked individuals

Facebook or site-specific settings

INVEST MORE OF YOUR MONEY IN YOU:

No account service fees

Low account minimums

$10.50 online equity trades

Later fees may apply

INVEST MORE OF YOUR MONEY IN YOU:

No account service fees

Low account minimums

$10.50 online equity trades

Later fees may apply
so many domains to explain!

why does my “smart” furnace keep shutting off?

“my decision tree thinks you’re not home”

why did my health insurance premium go up?

“sensors indicate that your average heart rate’s gone down”

why is my credit score so low?

“we predict you’ll default on your home loan next year”

why does the tutor keep giving me easy questions?

“you keep answering them incorrectly”
the future of HCI isn’t just about input and output...
the future of HCI isn’t just about input and output...

it’s also about explaining the stuff inside

so that people better understand the software-based world around them
questions?