

This is CS50

GETTING AN EDUCATION
FROM **NET**
IS LIKE TRYING TO
GET A DRINK
FROM A
FIRE HOSE...



2/3

of CS50 students had never taken CS before

what ultimately matters in this course is not so much where you end up relative to your classmates but where you end up relative to yourself when you began

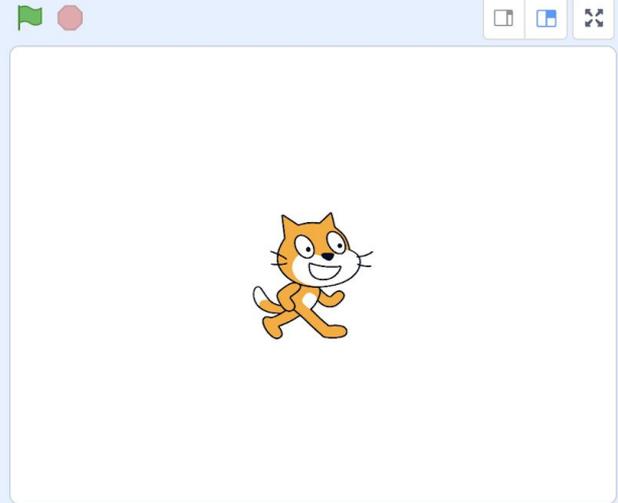


Code Costumes Sounds

- Motion
- Looks
- Sound
- Events
- Control
- Sensing
- Operators
- Variables
- My Blocks

Motion

- move 10 steps
- turn 15 degrees
- turn 15 degrees
- go to random position
- go to x: 0 y: 0
- glide 1 secs to random position
- glide 1 secs to x: 0 y: 0
- point in direction 90
- point towards mouse-pointer
- change x by 10
- set x to 0
- change y by 10
- set y to 0
- if on edge, bounce



Sprite: Sprite1

x: 0 y: 0

Show:

Size: 100 Direction: 90

Stage

Backdrops: 1

Sprite1

hello.c — hello [Codespaces] — x +

code.cs50.io Guest

EXPLORER

HELLO [CODESPACES]

- hello.c

```
1 #include <stdio.h>
2
3 int main(void)
4 {
5     printf("hello, world\n");
6 }
```

TERMINAL

```
$ make hello
```

> OUTLINE

> TIMELINE

The image shows a VS Code Codespaces interface. The Explorer sidebar on the left shows a project named 'HELLO [CODESPACES]' with a single file 'hello.c'. The main editor area displays the source code of 'hello.c', which includes a header file and a main function that prints 'hello, world\n'. Below the editor is a terminal window with the command '\$ make hello' entered. The interface is dark-themed and includes standard VS Code navigation icons on the left and window controls at the top.



8BB12
D9HXT

4G85



8BB12
D9HXT

4G85

In relay

11,000 test.

1100 Started Cosine Tapc (Sine check)
1525 Started Multi Adder Test.

1545

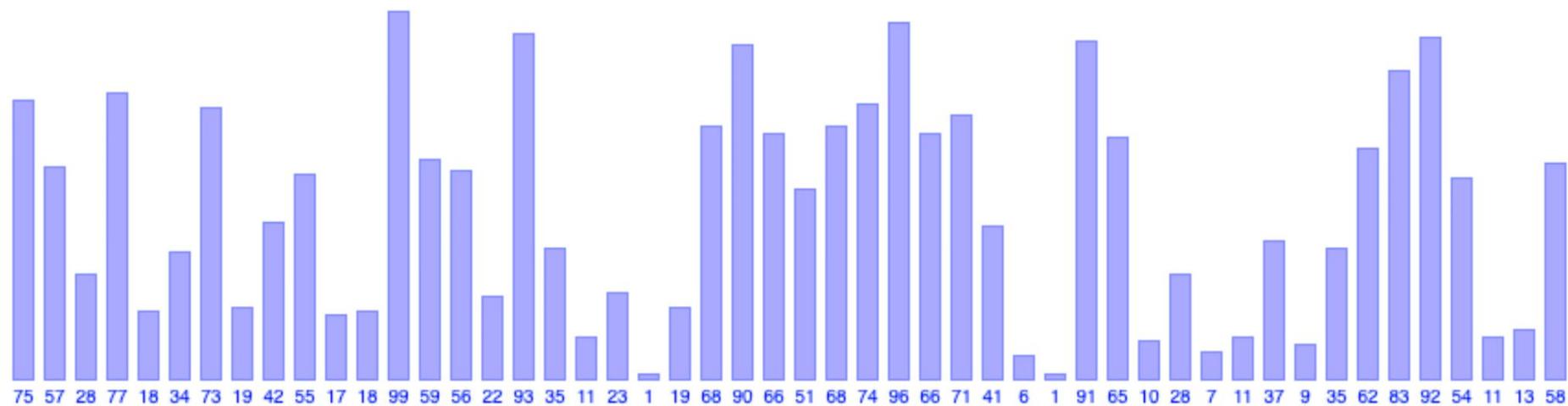


Relay #70 Panel F
(moth) in relay.

~~1630~~ 1630

First actual case of bug being found.
antennae started.

1700 closed down.





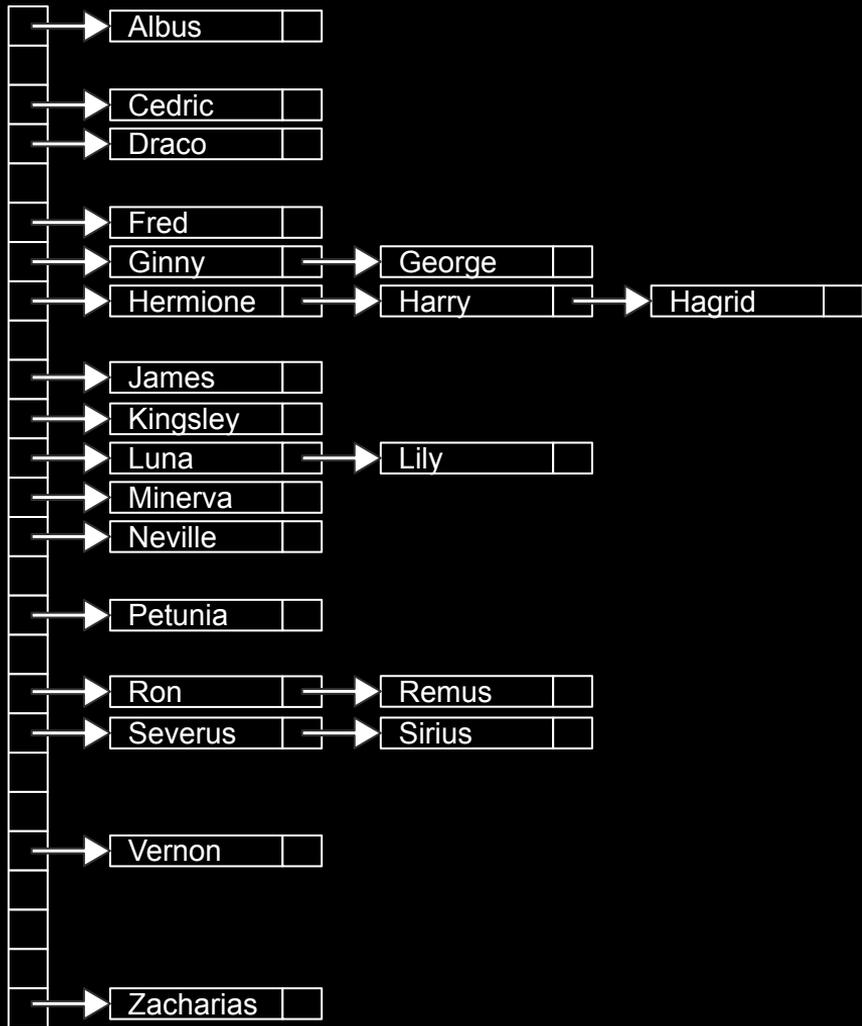
machine code

globals

heap



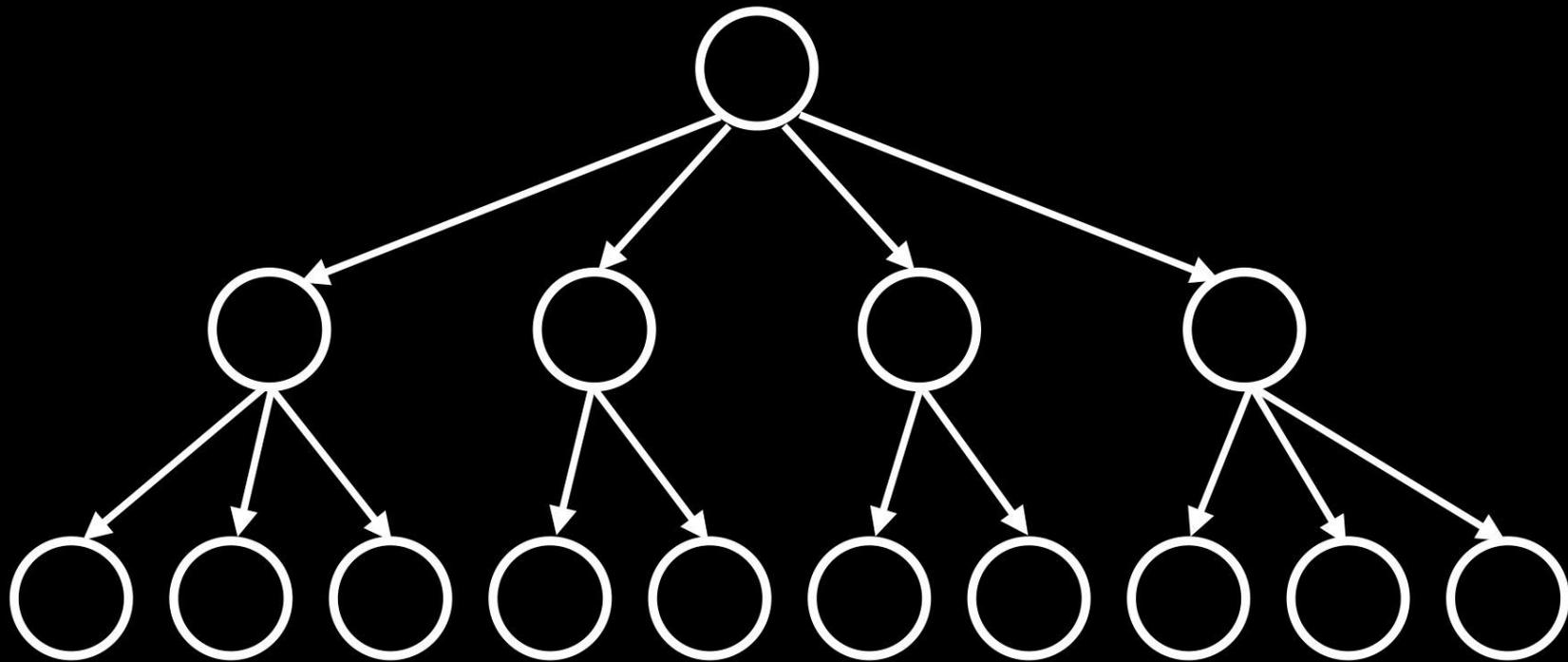
↑
stack



```
#include <stdio.h>

int main(void)
{
    printf("hello, world\n");
}
```

```
print("hello, world")
```



Untitled spreadsheet - Google x +

https://docs.google.com/spreadsheets/ Incognito

Untitled spreadsheet ☆

File Edit View Insert Format Data Tools Extensions Help

100% | \$ % .0 .00 123 | Default (Ari... | 10 | **B** *I* U A | ...

A1 | *fx*

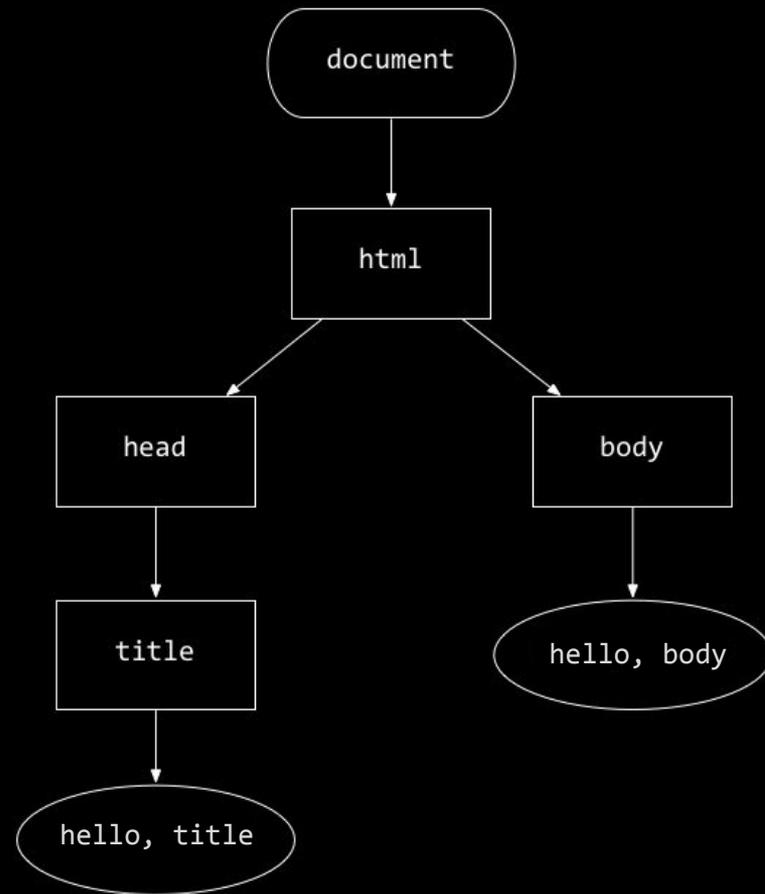
	A	B	C	D	E	F	G	H
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13								
14								

+ ≡ Sheet1 ▾

☆ <

```
<!DOCTYPE html>

<html lang="en">
  <head>
    <title>
      hello, title
    </title>
  </head>
  <body>
    hello, body
  </body>
</html>
```





Frosh IMs

Intramural Sports
for the class of 2007

[Calendar](#)

[Champions](#)

[FAQ's](#)

[Guide to Frosh IMs](#)

[Headlines](#)

[How to get involved](#)

[Photos](#)

[Point tallies](#)

[Records](#)

[Register](#)

[Registrants](#)

[Rules](#)

[Schedules and results](#)

[Whom to contact](#)

Headlines

Past headlines

For headlines posted prior to the past seven days, click [here](#).



EXPLORER ...

▼ PROJECT [CODESPACES]



> OUTLINE

> TIMELINE

TERMINAL



\$ █

CS50 Hackathon





THIS IS CS50

IHop

shuttle.harvard.edu

HARVARD

HARVARD SHUTTLE

36442



Step 1: [redacted] Scan your phone to connect with the QR code below. You'll be prompted to go to [redacted] to see the offer details. [redacted] Scan your QR barcode below and follow the on-screen prompts.

Step 2: Complete the survey.

Step 3: Pick up the code provided on your receipt.

FOR ALL OF YOUR OFFERS WE WILL BE HAPPY TO ASSIST YOU WITH A FREE HOTLINE STAFF OR OUR HELP LINE. WE'VE GOT YOU COVERED. 1-800-888-8888

OR

WHEN YOUR COMPUTER OR SMARTPHONE IS ON, GO TO [redacted] WITH CODE [redacted]



CS50 Fair









I took CS50.

Thank you



Office for the Arts at Harvard
Memorial Hall / Lowell Hall Complex



HARVARD

Faculty of Arts and Sciences

EDUCATION SUPPORT SERVICES



THE HARVARD
KROKODILOES





THE RESTAURANT
CHANGSHO

CS50

A stylized clapperboard icon is positioned above the letter '5' in the text 'CS50'. The clapperboard is white with black diagonal stripes on its top edge and a black bar across the middle.

ruse

Zoom

Helen Cho

Jonny Zhang



Abel



Sophie Edouard



Moni Radev



ehreteab



Joshua Ng

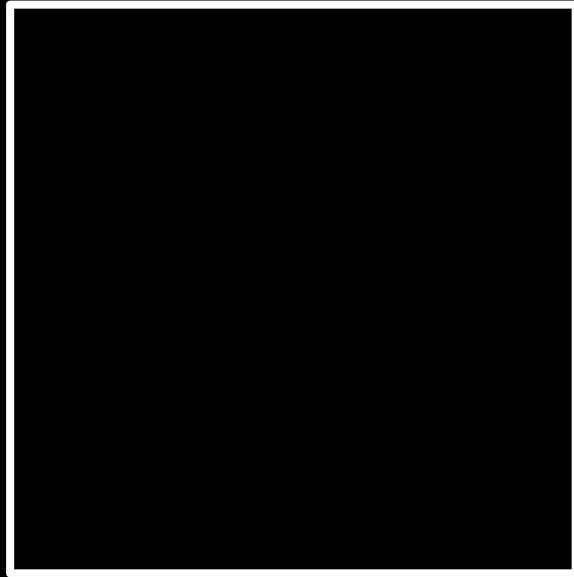


Montague Mawere

computational thinking

critical thinking

input →

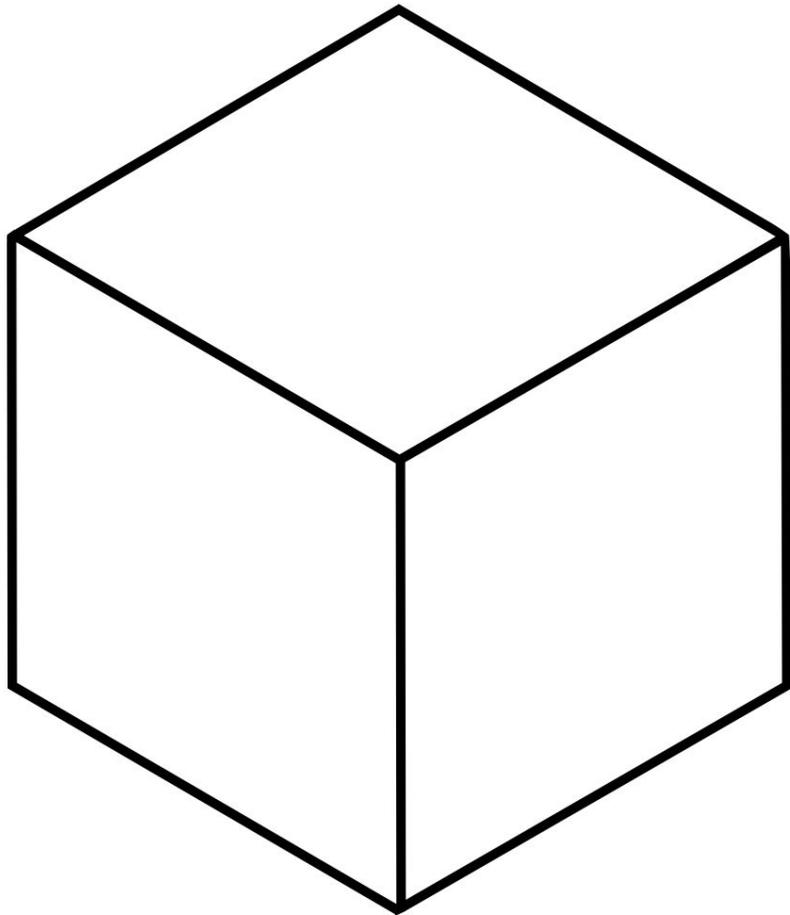


→ output

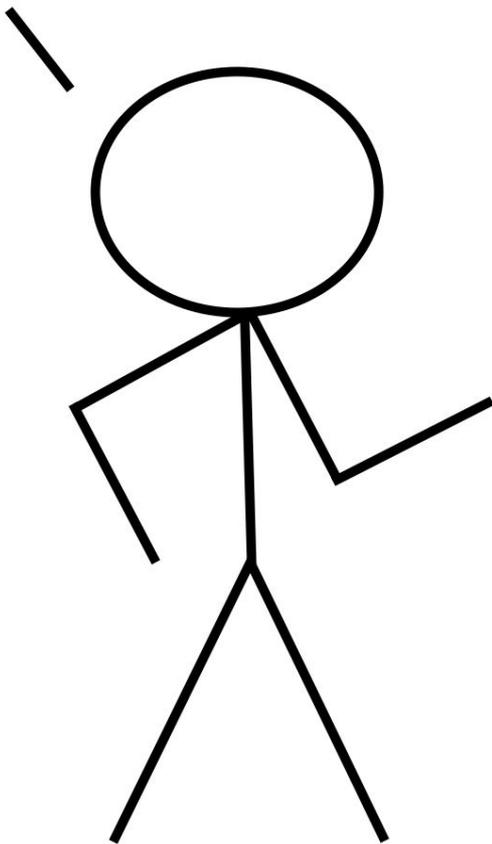
correctness, design, style

abstraction

precision



Hi



Install command-line tools

<https://developer.apple.com/xcode/>

<https://learn.microsoft.com/en-us/windows/wsl/about>

...

Learn Git

https://youtu.be/MJUJ4wbFm_A

...

Download VS Code

<https://code.visualstudio.com/>

Host a web site

<https://pages.github.com/>

<https://www.netlify.com/>

...

Host a web app

<https://aws.amazon.com/education/awseducate/>

<https://azure.microsoft.com/en-us/free/students/>

<https://cloud.google.com/edu/students>

<https://education.github.com/pack>

...

Keep reading

<https://www.reddit.com/r/learnprogramming/>

<https://www.reddit.com/r/programming/>

<https://stackoverflow.com/>

<https://serverfault.com/>

<https://techcrunch.com/>

<https://news.ycombinator.com/>

...

Stay in touch

cs50.harvard.edu/x/communities

CS50 Quiz Show

Jennifer 8. Lee '99

www.jennifer8lee.com



START



END

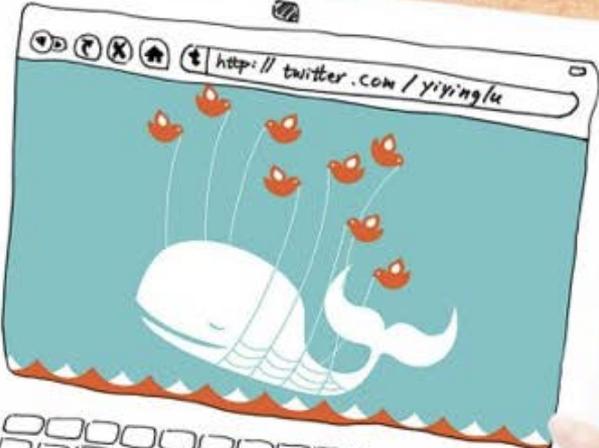
The World of Emoji

Harvard CS50 • November 2022

Jennifer 8. Lee • Emojination









Fried Dumplings!!!! Yum!



We can make those tmw

Yay!!    I'm surprised Apple doesn't have a dumpling emoji...

Oh. Good point

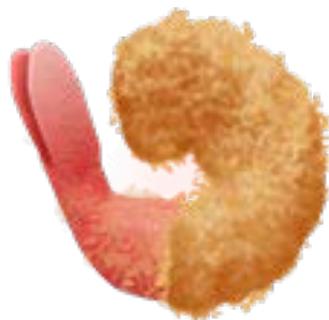


I decided to carry the emoji torch!

Haha. Did you make that?

Yep







Who Controls Emoji?





ORACLE®



Google



YAHOO!



\$18,000



Now \$50,000

\$75.00

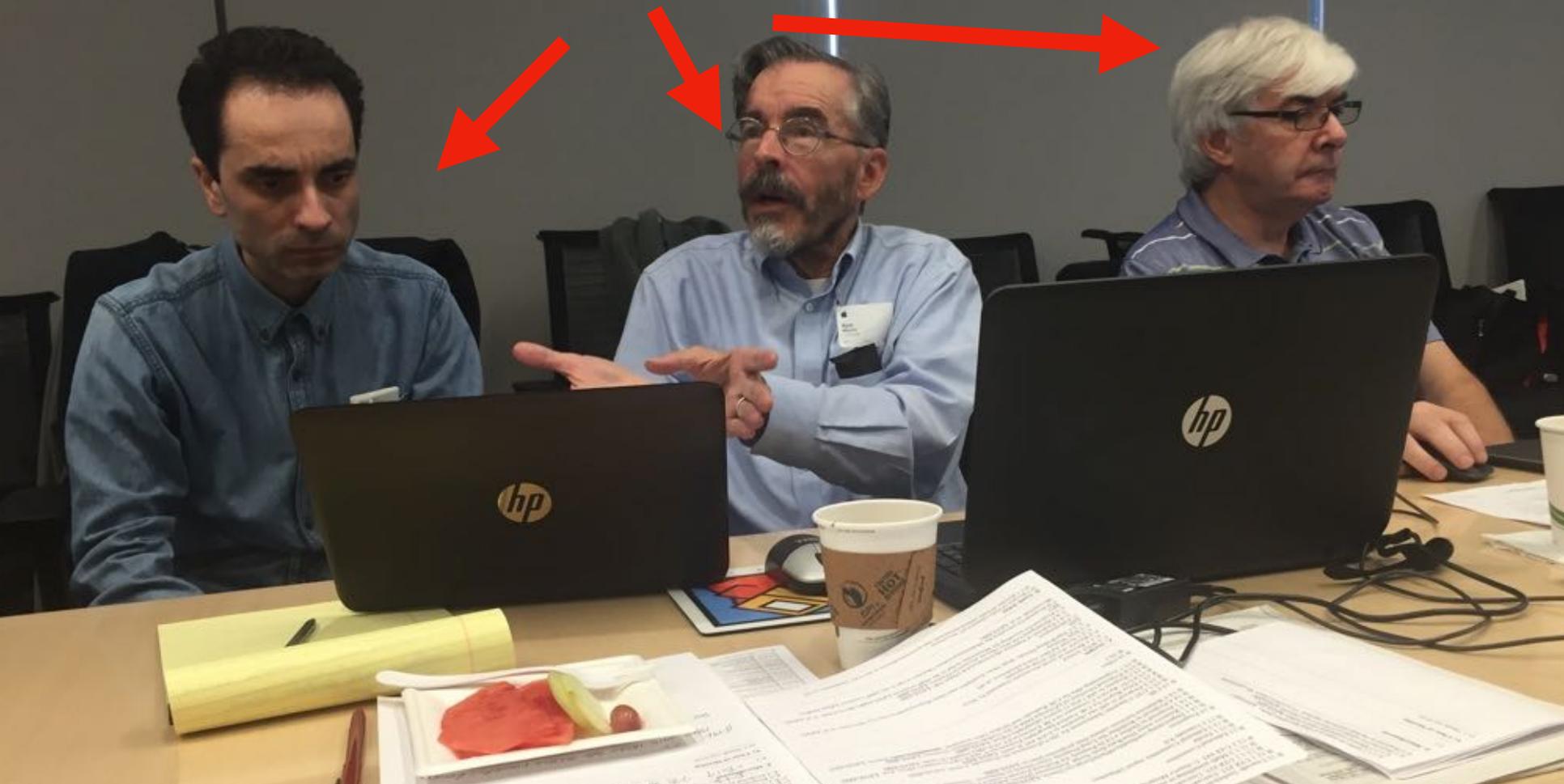


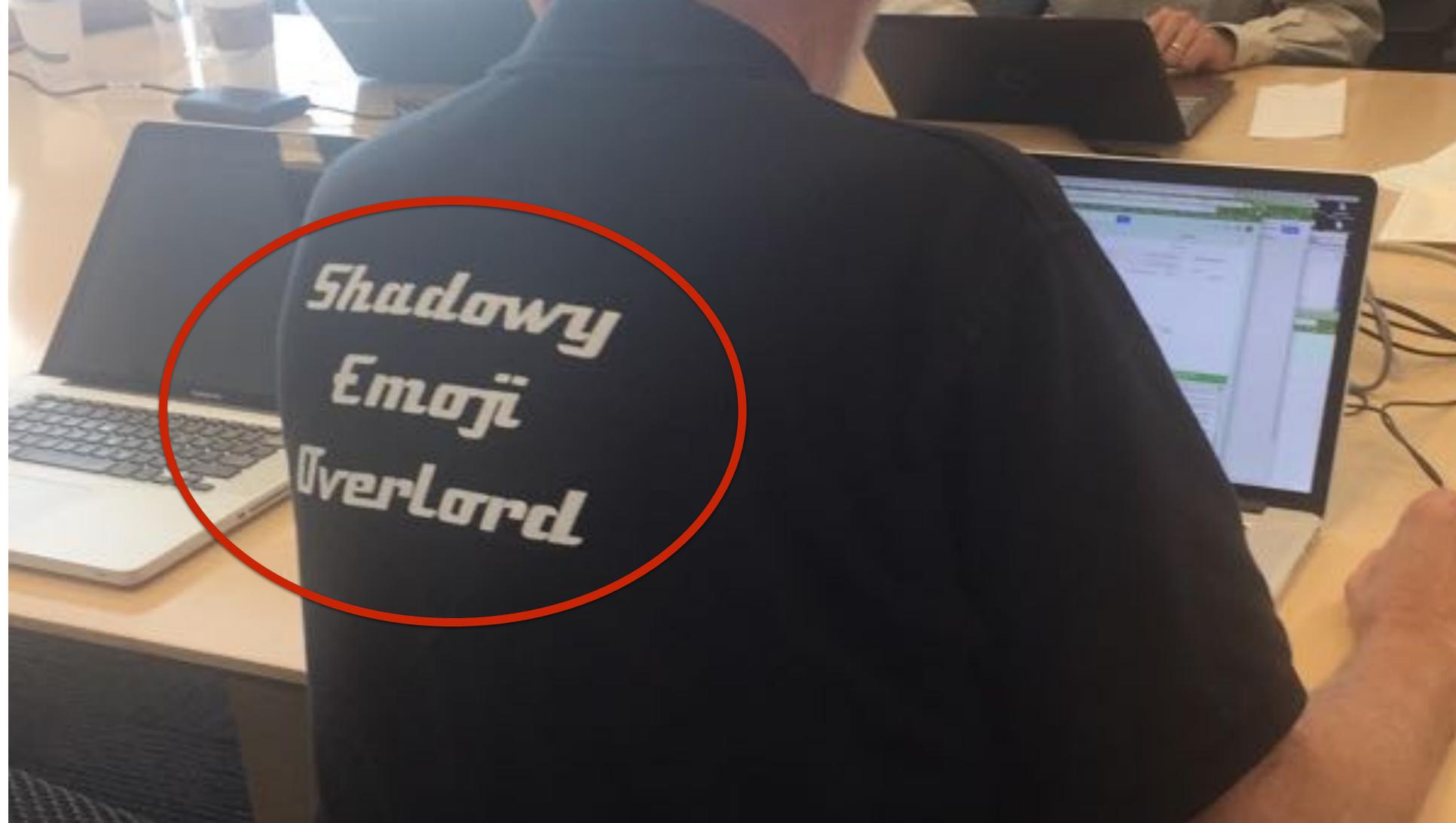




The room where it happens.

Emoji decisionmakers





*Shadowy
Emojii
OverLord*

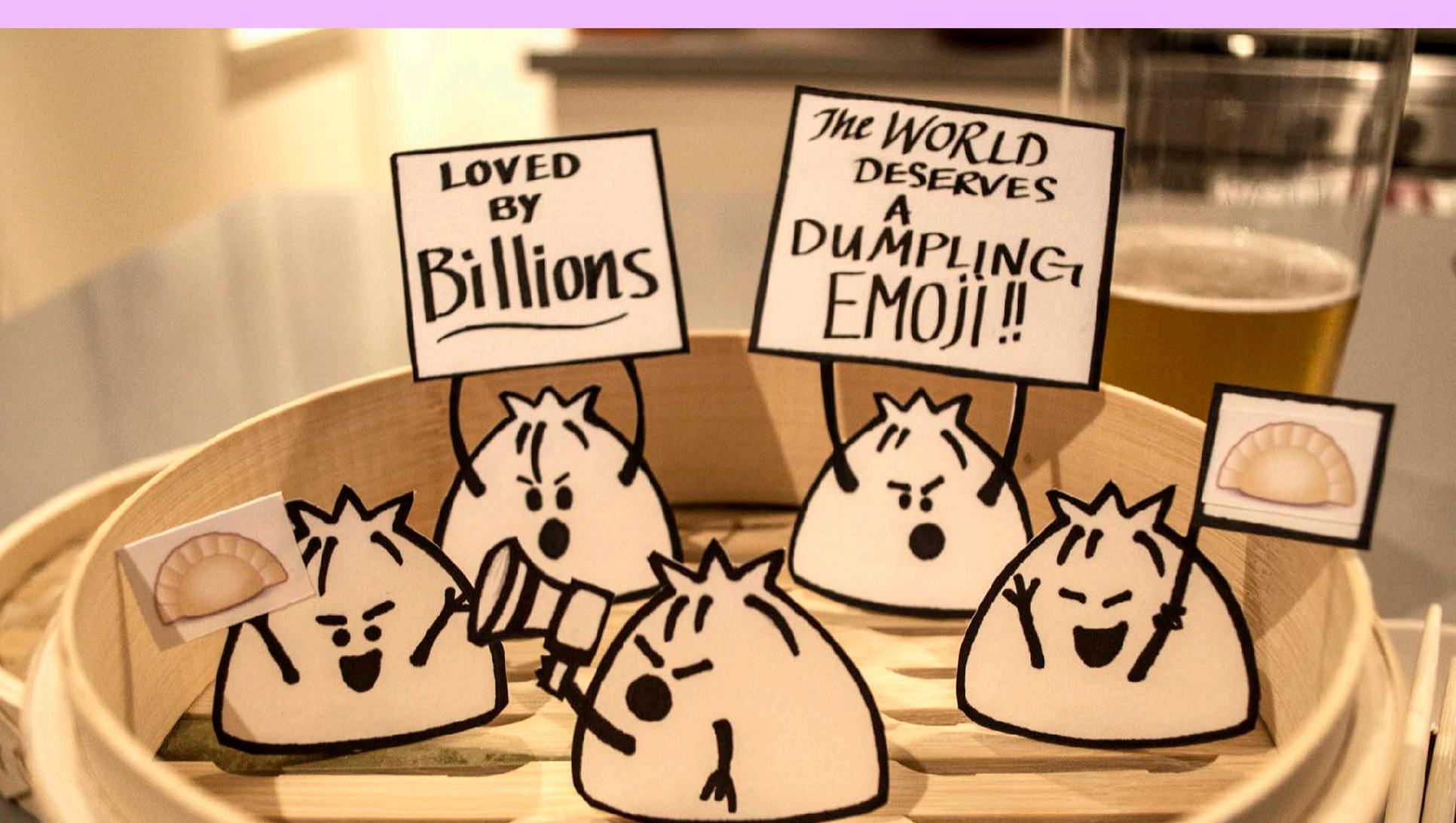


EMOJI
NATION



LOVED
BY
Billions

The WORLD
DESERVES
A
DUMPLING
EMOJI!!

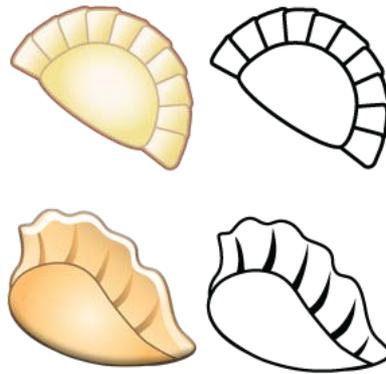


THE DUMPLING EMOJI PROJECT

Emoji by The People, for The People







Art created by Yiying Lu. Licensed for non-commercial use: free to share and use.

Dumpling Emoji Submission

To: Unicode Consortium

From: Jennifer 8. Lee, Yiying Lu, Kenny Lao, Namrata Mujumdar, and Emojination

Date: January 19, 2016

Abstract

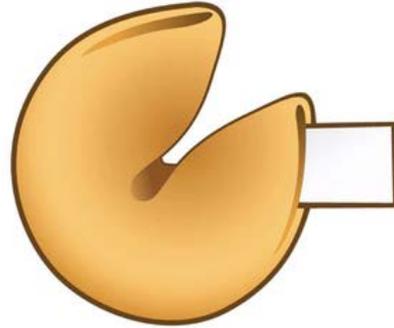
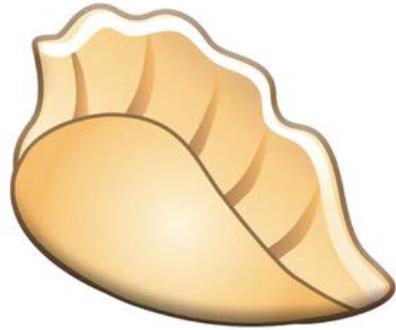
We are requesting the addition of a dumpling emoji, or more generally an emoji for “dough skin wrapped around a filling.” A dumpling glyph would fill a notable gap in the current emoji set and serve as a good “stem” emoji for related foods down the line. The formal name could be DUMPLING, with aliases that include POTSTICKER, GYOZA, JIAOZI, PIEROGI, and EMPANADA.

Introduction

Dumplings are one of the most pervasive foods in the world, culinarily native to four continents and served on all seven continents, including Antarctica.¹ As History.com

¹ “Dumplings in Antarctica.” The Antarctic Book of Cooking and Cleaning blog. February 2012. <http://www.theantarcticbookofcookingandcleaning.com/dumplings-in-antarctica.html> (Accessed November







Submitting Emoji Character Proposals

Submitting a

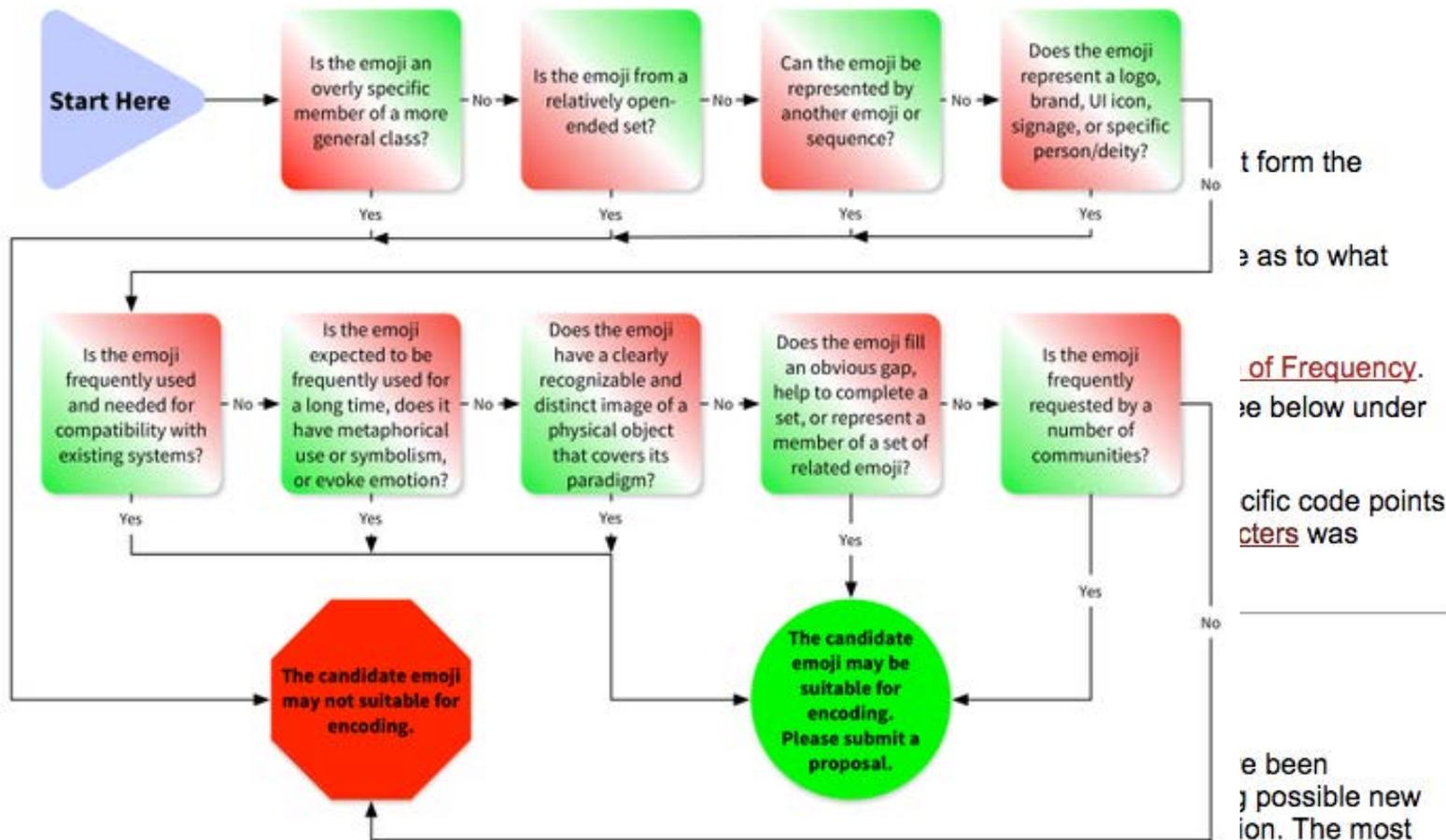
To submit a prop following informa

- A section th degree each
 - Some
 - Detail
- A set of ima Images.

Some useful exa (U+XXXXX) for p revised after can

Selection Fac

Initially, the Unico broadened to inc emoji. None of th



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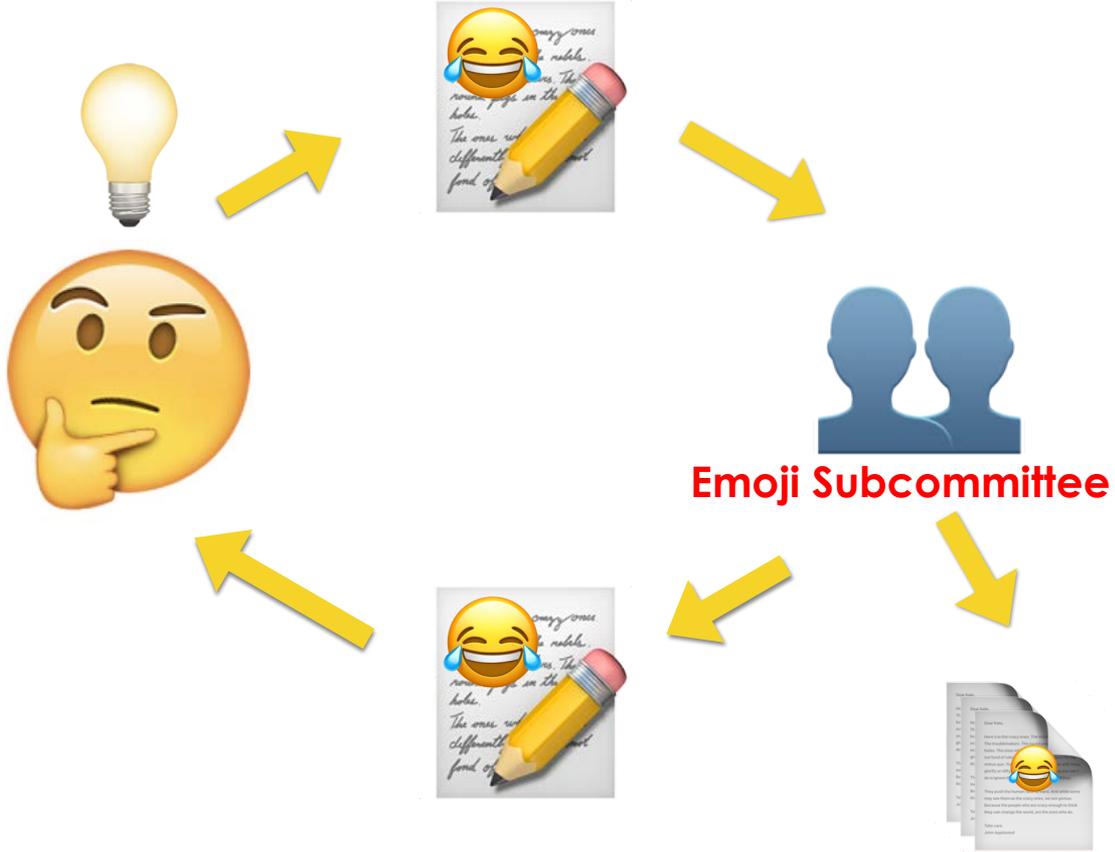
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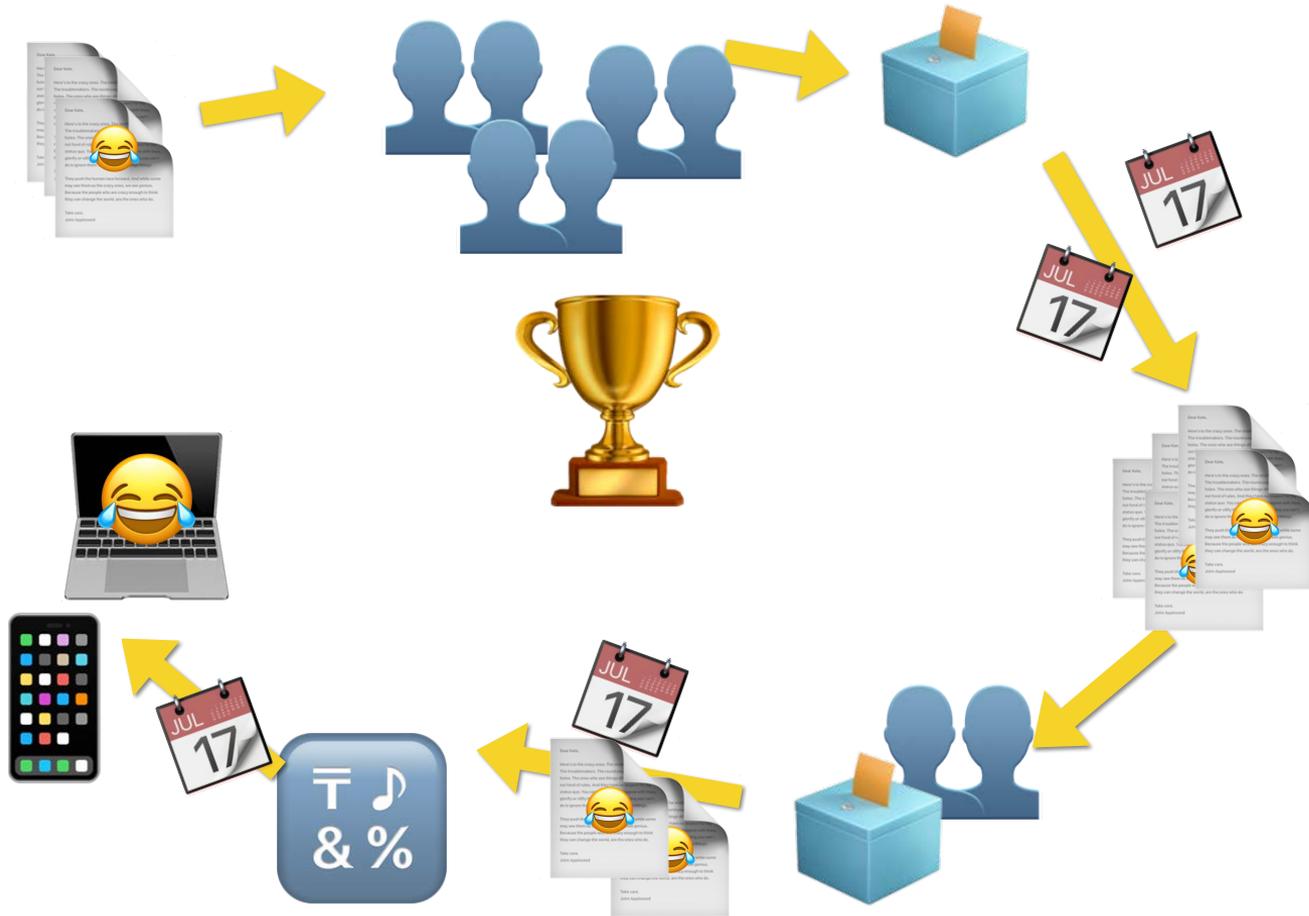
Factors for Inclusion

- Popular demand, frequently request (+)
- Multiple usages/meanings (+)
- Visual distinctiveness, can be recognized (+)
- Filling gap, “completeness” (+)
- Existing vendor compatibility (+)

Factors Against Inclusion

- Too specific, narrow (-)
- Redundant (-)
- Not visually discernible (-)
- No logos, brands, deities, celebrities (-)
- No more flags (X)

Unicode Technical Committee





18-24 months (or more)



EMOJI
NATION



Why does Unicode control emoji?



START

END



1999 • Docomo





2007





Enable everybody, speaking every language on the Earth, to be able to use their language on computer and smartphones.



**Unicode Consortium
incorporated in 1991.**



Three main projects

- **Encoding characters (including emoji!) — now over 100,000 assigned**
- **Localization Resources
(Common Locale Data Repository, “CLDR”)**
- **Programming Libraries
(International Components for Unicode, “ICU”)**



SEALDEER = CLDR



A Unicode **code point** is a unique number assigned to each Unicode character.



U+1F602

128514

11111011000000010

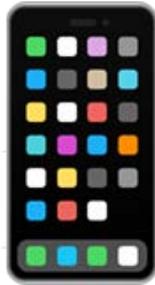
2010 • Unicode 6.0



2011



2011



Emoji Usage over Time



What does



emoji mean?



|



meaning from a guy



meaning from a girl



what does mean from a guy



what does mean flirting



upside down face text



upside down smiley alt code



emojipedia



meaning

Who Can Propose Emoji?





Google Form! April-August

(recently)

START

END



UTC Document Submission: Hijab Emoji

To: UTC

From: Rayouf Alhumedhi

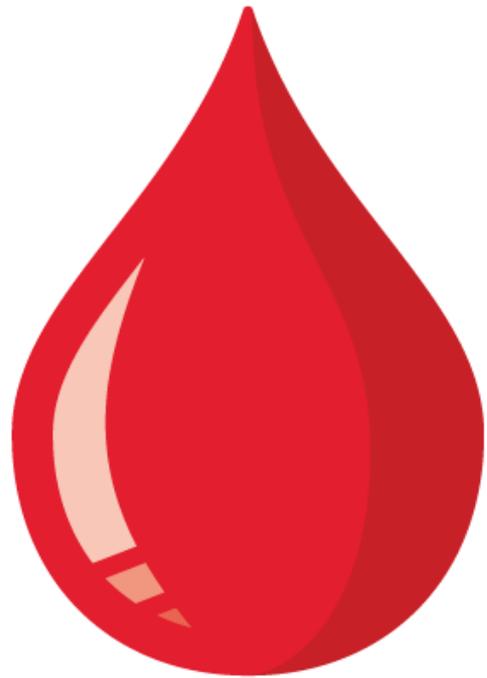
Date: 09/26/16

In the age of digitalization, pictures prove to be a crucial element in communication. Emoji's are more impactful and utilized than ever before. Millions use them to convey feelings, appearances and stories. I applaud Unicode for the diversification of emoji's in recent years. However, this does not mean it should stop now. With the amount of difference in this world, we must be represented. I'm here to discuss the addition of a woman wearing a headscarf emoji.

Roughly 550 million Muslim women on this earth pride themselves on wearing the hijab. With this enormous number of people, not a single space on the keyboard is reserved for them. Most obviously, women wearing the hijab aren't mutually exclusive to one skin tone, so with the help of the Fitzpatrick Modifier, we would be able to develop an emoji that represents religious and racial diversity.











Proposal to Add Emoji: Face With One Eyebrow Raised

Maximilian Merz, `unicode@mxmerz.de`

November 5, 2015

Abstract

Currently, there is no emoji encoded in Unicode that shows a face with one raised eyebrow. A raised eyebrow is a widely used facial expression and equally widely recognized as conveying a variety of meanings, centered around scepticism, surprise, disagreement, and being impressed. This proposal presents evidence of high usage of emoticons expressing similar mimics, suggesting a high expected usage level for the suggested emoji. An emoji with the name `FACE WITH ONE EYEBROW RAISED` is proposed to be included in the Unicode standard.









10. ONE-PIECE SWIMSUIT

Why?

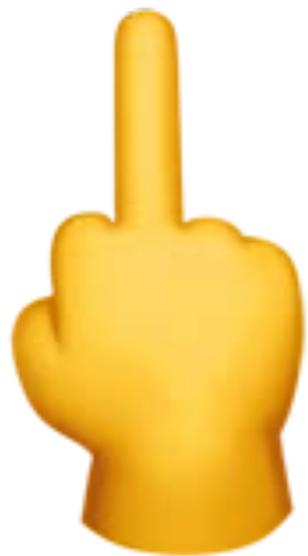
A person wanting to indicate the use of swimwear can't use the existing BIKINI?

Is this really necessary?

What about a Victorian bathing costume?

Or a wetsuit? Or water wings?

Do not encode.







Art created by Bruno Leo Ribeiro

Sauna Emojis Submission

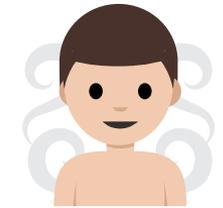
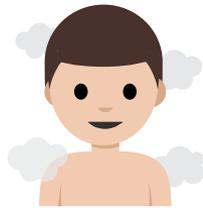
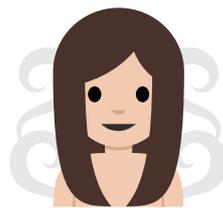
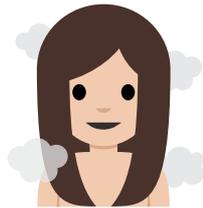
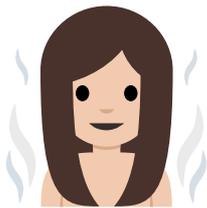
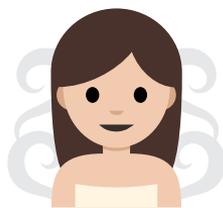
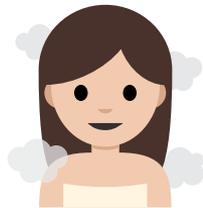
To: Unicode Consortium

From: Ministry for Foreign Affairs of Finland (co-ordinator Petra Theman, Director of Public Diplomacy)

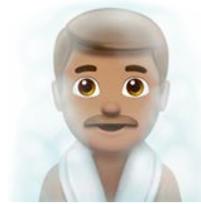
Date: 13.05.2016

Abstract

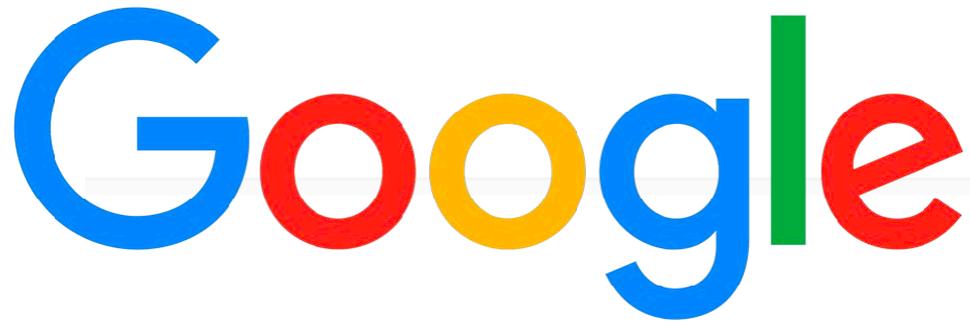
We are requesting the addition of the sauna emojis, both male and female person going into sauna. The sauna emojis would fill a notable gap in the current emoji set and serve as an important addition to activity, people and location emojis. The formal names could be SAUNA MAN and SAUNA WOMAN.



Person in Steamy Room







L2/16-160

Expanding Emoji Professions: Reducing Gender Inequality

Contact: Rachel Been (been@google.com), Nicole Bleuel (nbleuel@google.com), Agustin Fonts (afonts@google.com), Mark Davis (markdavis@google.com)

Introduction

Google wants to increase the representation of women in emoji and would like to propose that Unicode implementers do the same. Our proposal is to create a new set of emoji that represents a wide range of professions for women and men with a goal of







Emojination Emoji



START

END



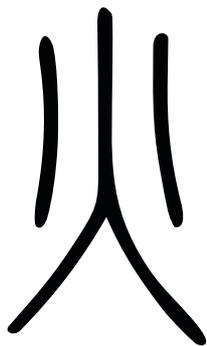
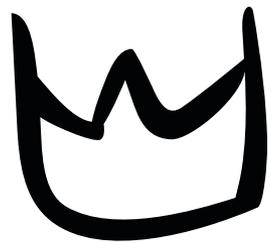
Why care?

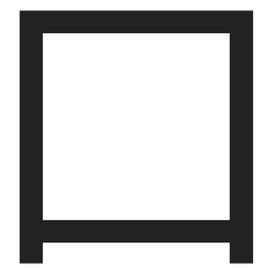
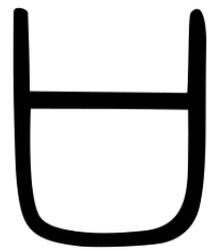
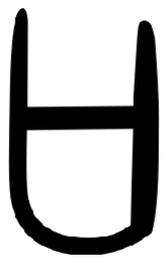


START

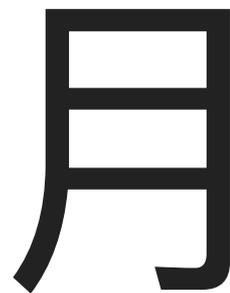
END

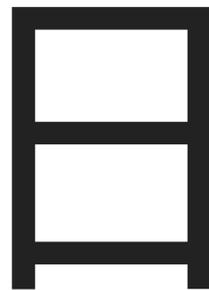
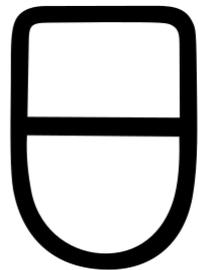
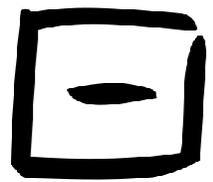
















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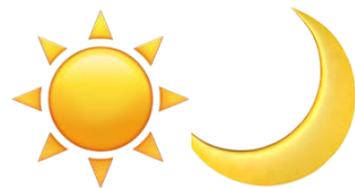
月

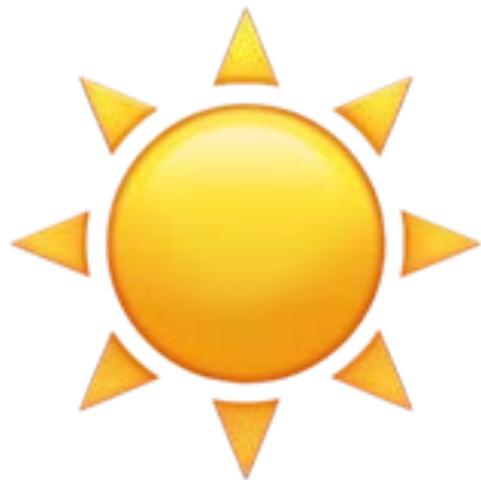


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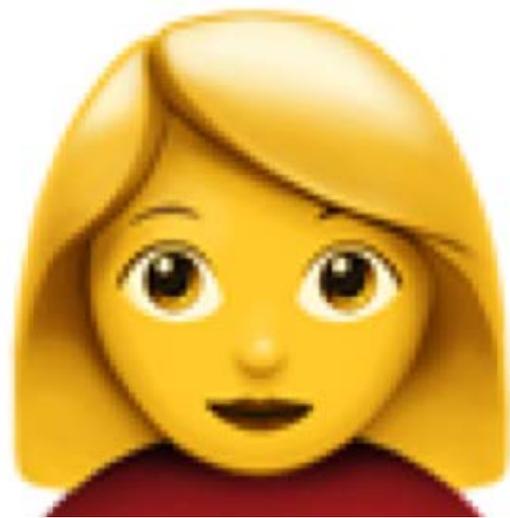
安







女



子





好





女

姦姦



婪



奴



嫉



妍



THE HANMOJI HANDBOOK

YOUR GUIDE TO THE CHINESE LANGUAGE
THROUGH EMOJI



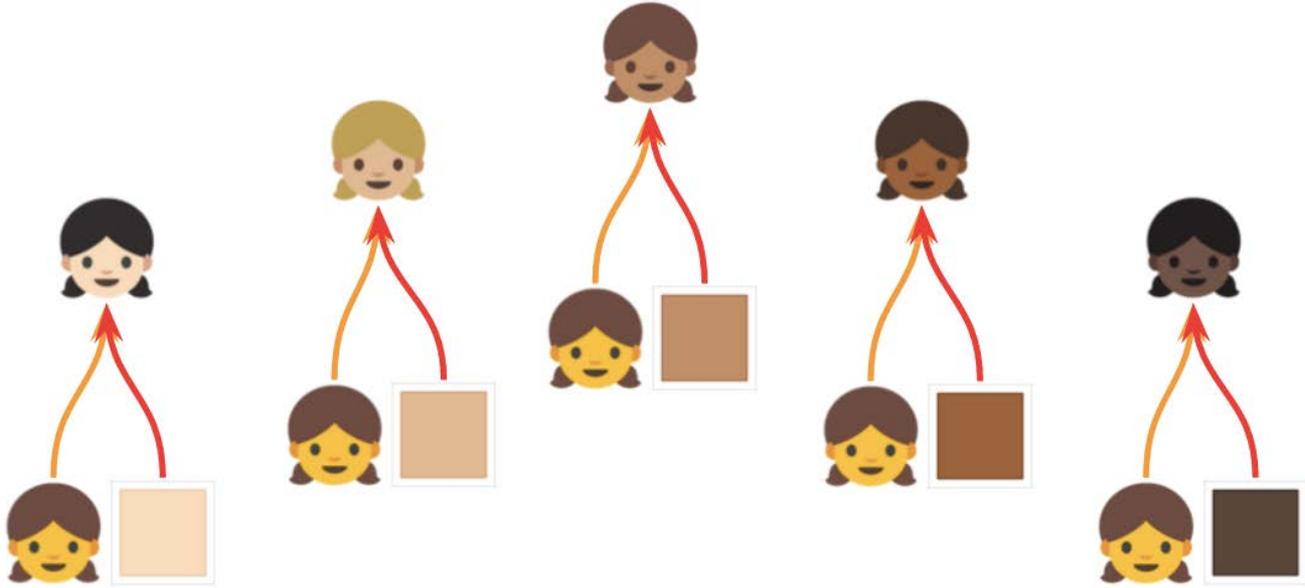
Jason Li, An Xiao Mina, and Jennifer 8. Lee

From
MIT Press!

Underneath the Hood



Skin Tones



The Power of Combining Emoji

START

END

“ZWJ”



+



=





=



+





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+





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+





Farming		<p>Woman:  +  [U+1F469] + [U+1F69C]</p> <p>Man:  +  [U+1F468] + [U+1F69C]</p>	Farmer
Food service		<p>Woman:  +  [U+1F469] + [U+1F373]</p> <p>Man:  +  [U+1F468] + [U+1F373]</p>	Chef, cook
Education		<p>Woman:  +  [U+1F469] + [U+1F3EB]</p> <p>Man:  +  [U+1F468] + [U+1F3EB]</p>	Teacher, professor





36	X1F9CD 1F3FD 200D 2640 FE0F 200D X1F9CD 1F3FE 200D 2640 FE0F	 	STANDING WOMAN, MEDIUM SKIN TONE; ZWJ; STANDING WOMAN, MEDIUM-DARK SKIN TONE.
37	X1F9CD 1F3FD 200D 2640 FE0F 200D X1F9CD 1F3FF 200D 2640 FE0F	 	STANDING WOMAN, MEDIUM SKIN TONE; ZWJ; STANDING WOMAN, DARK SKIN TONE.
38	X1F9CD 1F3FE 200D 2640 FE0F 200D X1F9CD 1F3FE 200D 2640 FE0F	 	STANDING WOMAN, MEDIUM-DARK SKIN TONE; ZWJ; STANDING WOMAN, MEDIUM-DARK SKIN TONE.
39	X1F9CD 1F3FE 200D 2640 FE0F		STANDING WOMAN, MEDIUM-DARK SKIN TONE; ZWJ; STANDING WOMAN,

Gender Inclusivity







Child?

HUMANS AND TECHNOLOGY

Meet the designer behind gender-neutral emoji

Paul D. Hunt pushed the Unicode Consortium away from stereotypical gender iconography.

By Tanya Basu

August 23, 2022





Child



Adult



Older Adult





















Mx. Claus



LIFESTYLE

Apple riles online critics with pregnant man, other progressive emojis

By Ben Cost

January 28, 2022 | 12:49pm | Updated

Save



Apple's new iOS 15.4 will include a pregnant man, nonbinary person with a crown and other inclusive symbols.

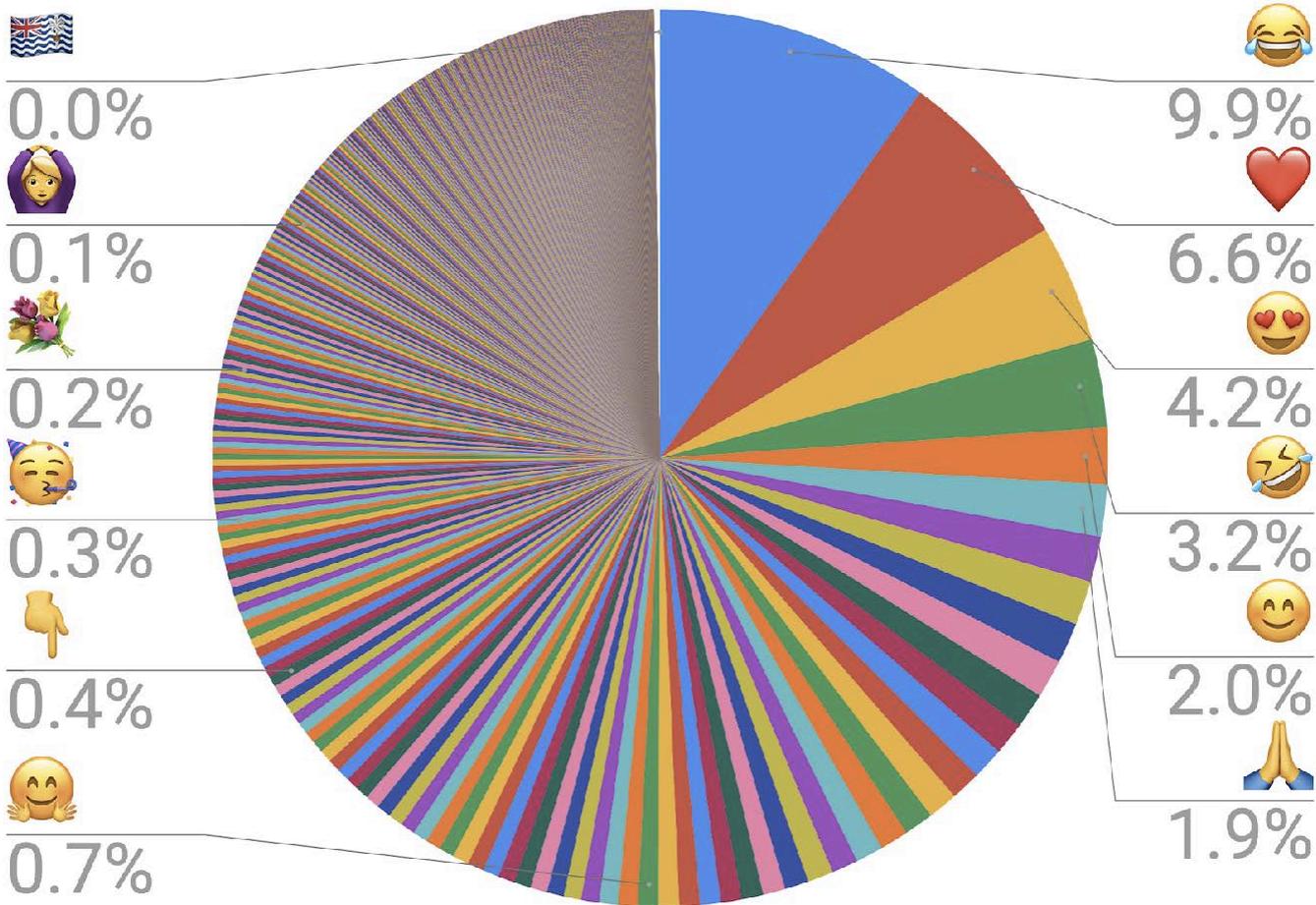
Emojipedia

Emoji Stats



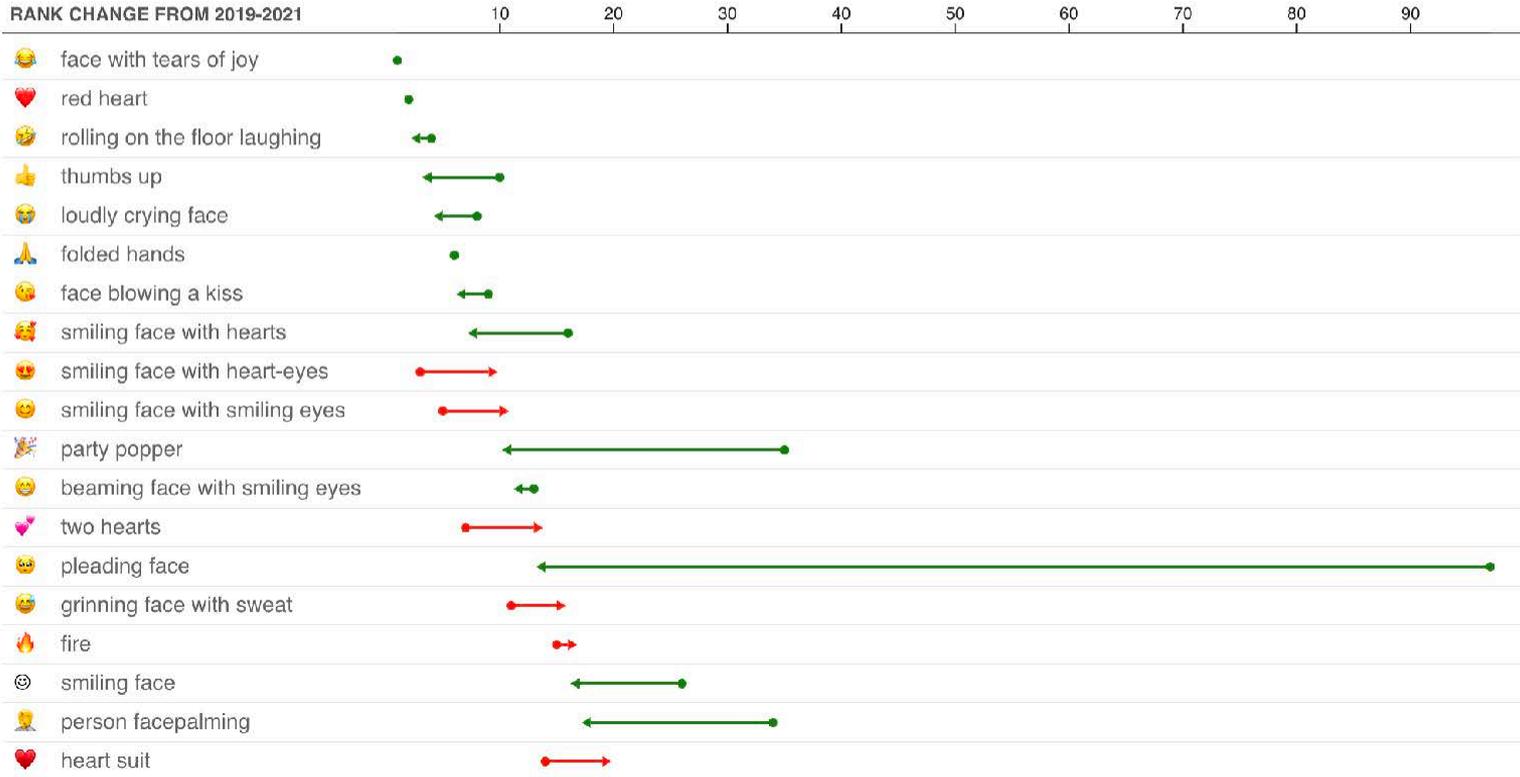
START

END

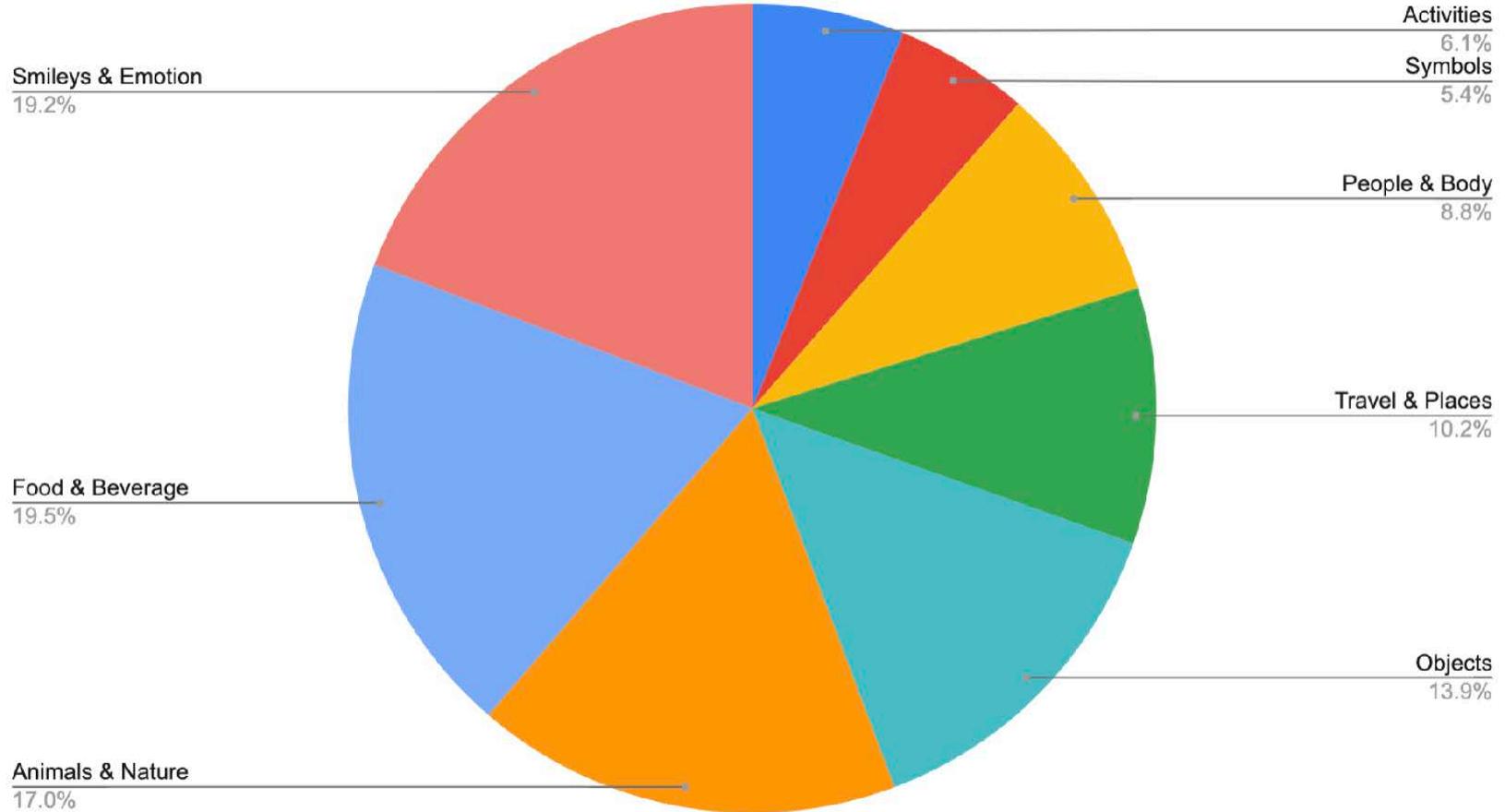


Emoji Frequency

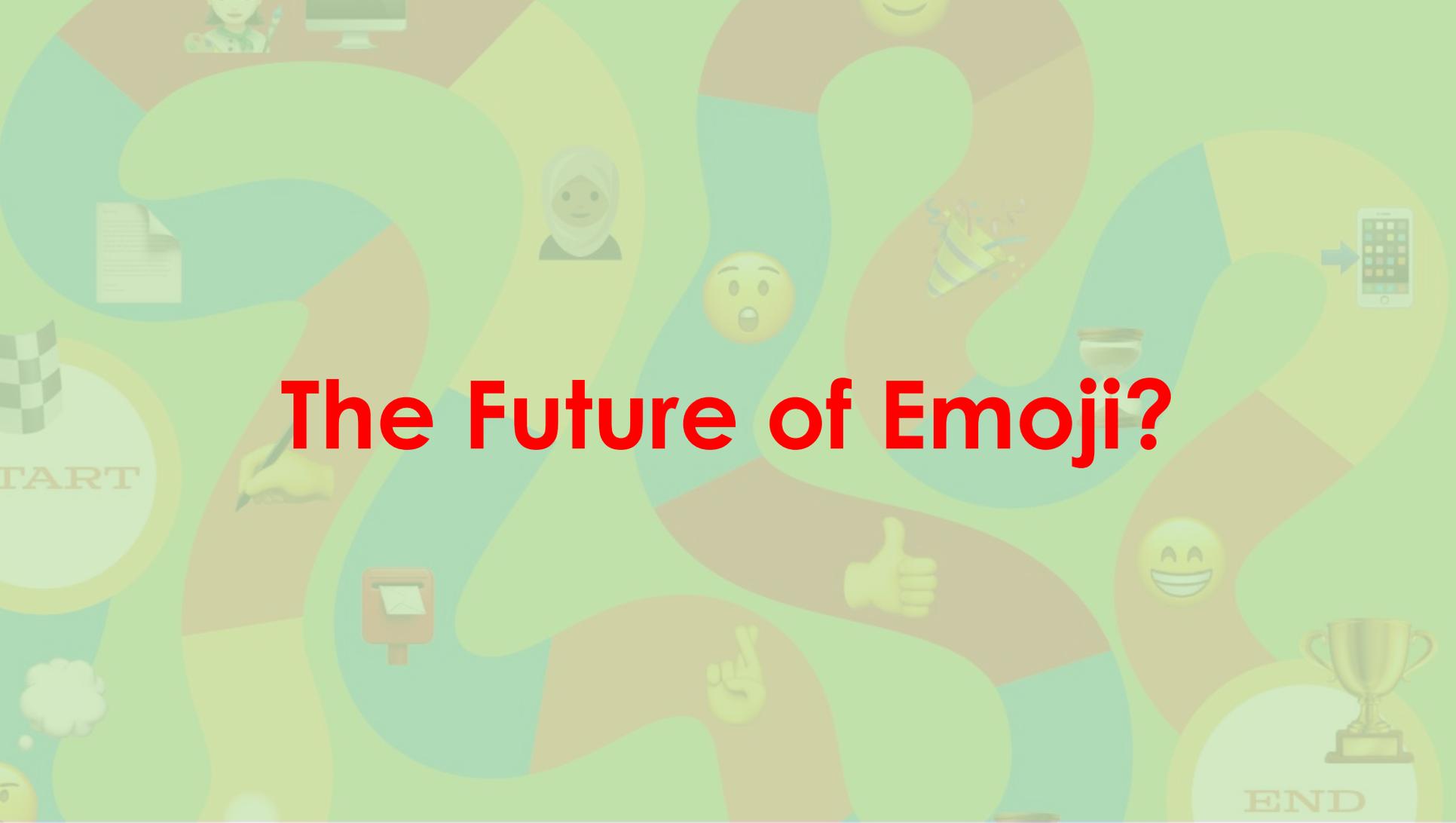
RANK CHANGE FROM 2019-2021



2022 Emoji Proposals



The Future of Emoji?



START

END

$B <: A$

A

$C <: A$

$B <: D$

$A \rightarrow B <: C \rightarrow D$

$D \rightarrow B$



Coded Hashes of Arbitrary Images

(or: the last frontier of emoji encoding)

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Emojination

2016-05-02

<https://srl295.github.io>

1 Introduction

Emoji are pictographs (pictorial symbols) that are typically presented in a colorful cartoon form and used inline in text. [...] In Unicode 8.0, there is a total of 1,282 emoji, which are represented using 1,051 code points.¹

Recently, there has been considerable interest in adding newly created pictorial symbols, not found in any existing character set, to the Unicode Standard as emoji.² Advocacy groups and others request these code points because Unicode plain text remains the dominant interoperable interchange format for messaging. In practice, before a new emoji can be used, a code point must be assigned and be recognized by the sender and receiver. The stated longer-term goal for Unicode is that implementations should support “embedded graphics, in addition to the emoji characters”.³

In this proposal, we describe a mechanism to uniquely identify arbitrary images within a plain-text Unicode character sequence. This will allow implementers to create their own emoji without needing to request and wait for the assignment of a code point. The basic

Re: QID Emoji Proposal

From: Mark Davis

Date: 2019-01-25, last revised 2019-03-28

For many reasons, the introduction of emoji characters has been beneficial to Unicode and the languages that it serves. For example, because emoji support requires more complex features and supplementary code points, emoji implementations have also helped improve support of complex scripts used by billions of people around the world.

But the standard emoji characters are a closed set. Suppose that someone wants a *White-crested tiger heron* emoji or a *Raclette* emoji. Right now they go through a process of writing a proposal for a new character, and providing evidence of expected usage and other criteria. Because Unicode is limited to a relatively small number of new emoji per year, we normally require the expected usage to be above median (ie, roughly the frequency of the hamburger or of the Swiss flag).

While it is possible for a platform to support ZWJ sequences that are valid (but not [RGI](#)), the same is not true of single characters. A platform can use private-use characters (there are well over 100,000 Unicode private-use (PU) characters available) but those have major problems:

A. **Collisions:** there isn't anything to prevent two different platforms from using the same PU



What's Coming 2022?



emotion

Nº	IMAGE	CLDR SHORT NAME	CLDR KEYWORDS	Proposal	Additional Sequ
1		LIGHT BLUE HEART	Cyan, teal, light blue, heart	L2/21-202	0
2		GRAY HEART	Gray, silver, slate, heart	L2/21-201	0
3		PINK HEART	Pink, like, cute, love, heart	L2/21-203	0

animal-bird

Nº	IMAGE	CLDR SHORT NAME	CLDR KEYWORDS	Proposal	Additional S
11		WING	flying, angelic, aviation, bird, mythology	L2/21-198	0
12		BLACK BIRD	bird, crow, raven, black,	L2/19-307	0
13		GOOSE	bird, honk, fowl, silly	L2/21-219	0

Animals & Nature

plant-flower

Nº	IMAGE	CLDR SHORT NAME	CLDR KEYWORDS	Proposal	Additional
9	 A cluster of small purple flowers on a green stem with two green leaves.	HYACINTH	flower, nowruz, haftsín, haftseen, purple, lavender, bluebonnet, lupine, snapdragon	L2/21-215	0

animal-marine

10	 A blue jellyfish with purple tentacles and a white bell.	JELLYFISH	marine, invertebrate, jelly, stinger, burn, ouch	L2/21-217	0
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animal-mammal

Nº	IMAGE	CLDR SHORT NAME	CLDR KEYWORDS	Proposal
14		MOOSE FACE	antlers, mammal, animal, elk	<u>L2/21-197</u>
15		DONKEY	mule, burro, stubborn, mammal, animal	<u>L2/21-196</u>

Food & Drink

food-vegetable

Nº	IMAGE	CLDR SHORT NAME	CLDR KEYWORDS	Proposal	Additional S
7		GINGER	spice, root, beer,	L2/21-200	0
8		PEA POD	edamame, pod, beans, vegetable, legume, pea	L2/21-199	0

Nº	IMAGE	CLDR SHORT NAME	CLDR KEYWORDS	Proposal	Additional Sequ
20		WIRELESS	internet, computer, network	L2/21-191	0
religion					
21		KHANDA	Sikh, religion	L2/21-223	0

face-neutral-skeptical

Nº	IMAGE	CLDR SHORT NAME	CLDR KEYWORDS	Proposal
4		SHAKING FACE	Shock, shaking, face, earthquake, vibrate,	L2/21-214

Objects

clothing

Nº	IMAGE	CLDR SHORT NAME	CLDR KEYWORDS	Proposal
18		FOLDING HAND FAN	fan, cooling, hot, heat, shy, coy, spread, flutter, dance	L2/21-192
19		HAIR PICK	Afro, hair, pick, comb	L2/21-218

Activities

musical-instrument

Nº	IMAGE	CLDR SHORT NAME	CLDR KEYWORDS	Proposal
16		MARACAS	music, noise, celebrate, shake, instrument, rattle, rhythm, percussion	L2/21-194
17		FLUTE	toot, flautist, recorder, music, woodwind, bamboo, pipe, fife	L2/21-193

Beyond 2022



RIP Family Emoji

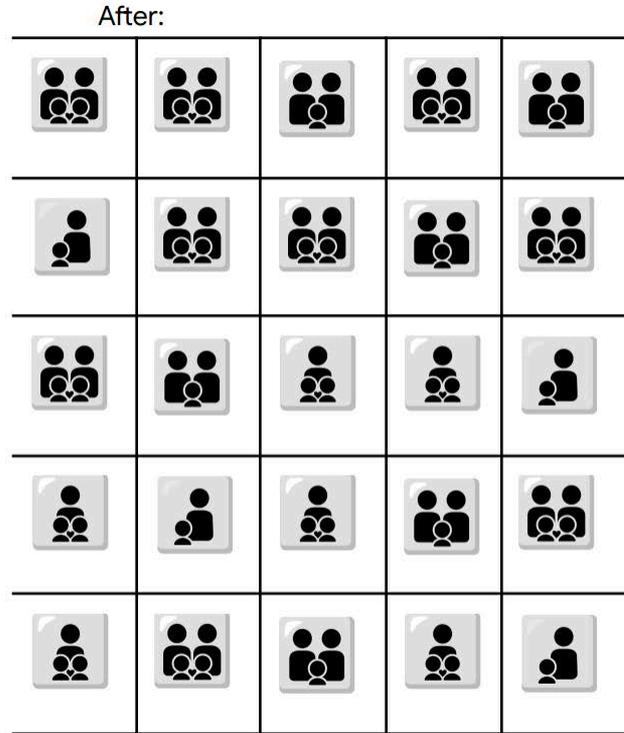
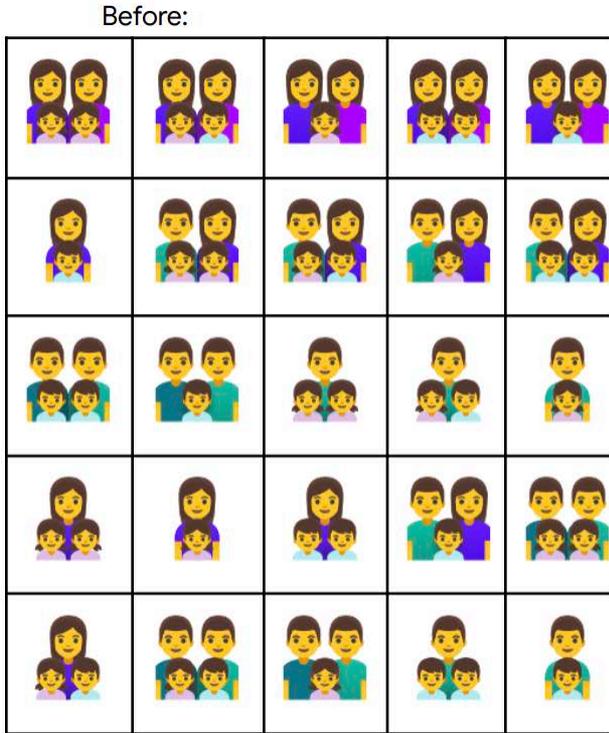


Fig 4. Family Emoji today (left), Family Emoji moving forward (right)

Emoji Directionality

Exploring Emoji Directionality

Author: Sean Stewart and Jennifer Daniel on behalf of the Emoji Subcommittee (ESC)

Date: Oct 19, 2022

Introduction

As the ESC reviews requests from the public for new emoji, we encounter increasing evidence that the existing corpus of emoji is hitting or is rapidly about to hit thresholds of saturation. In order for emoji to operate at the speed of language online, the ESC's time and energy has turned towards looking at the emoji experience more holistically—that is, to see which improvements can be made to the existing repertoire of emoji—to address fundamental needs.

While there are no plans to stop adding new emoji characters, an incredibly powerful aspect of written language is that it consists of a finite number of characters that can "do it all". In this spirit, we are here to challenge a presumption that the primary way for emoji to move forward is to add more of them to the Unicode Standard. As the ESC actively explores viable paths forward, one track has demonstrated great potential and

**Why does emoji
direction matter?**

**Because not all
languages
run in the
same direction.**

Arabic.

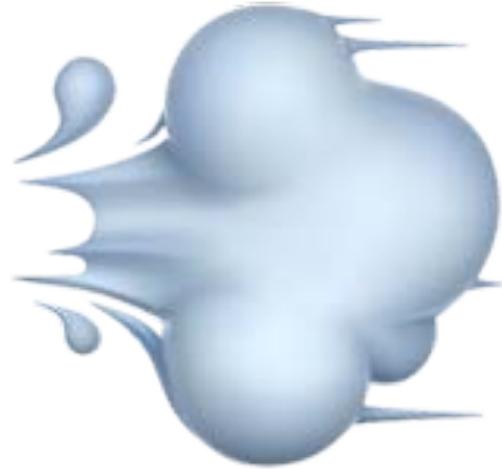
Right to Left



Left to Right



Right to Left



Left to Right



Left-to-Right vs. Right-to-Left

Example of Semantic Changes

Directionality	Sequence	Meaning
LTR		<i>Quickly running away from a line of cars</i>
RTL		<i>Warning to not run behind car fumes</i>

Inline Sticker Support

5. Inline Emotes / Stickers Support

At this time we have no update since the Q3 UTC meeting on the subject of Inline Emotes ([L2/22-180](#)). Vendors continue to investigate which of the presented directions (if any) continue to make sense in today's market. Internet communication media continue to improve support for the sharing of customized, arbitrary, emoji-like images in-line with text, and platform vendors continue to show interest in improving this functionality to be platform-independent.





This was CS50