# This is CS50

# Thank you

Office for the Arts at Harvard

Memorial Hall / Lowell Hall Complex

HARVARD

Faculty of Arts and Sciences

EDUCATION SUPPORT SERVICES

CS50

RED
ANTON BAUER
SMALL HD

Slider
Wide
Camera 5
ME 2 PGM
Camera 7
Camera 6
PREVIEW
PROGRAM
SAMSUNG

HARVARD

HARVARD

HARVARD

CS50
Harvard College
@Sanders Theatre
CS50
Harvard Coll
@Sanders Theatre
HARVARD
SZU
STANFORD
UNIVERSITY

## You might like

**Big Bird**
@BigBird

Follow

**Oscar the Grouch**
@OscarTheGrouch

Follow

**Grover**
@Grover

Follow

Show more

twitter.com/CountVonCount

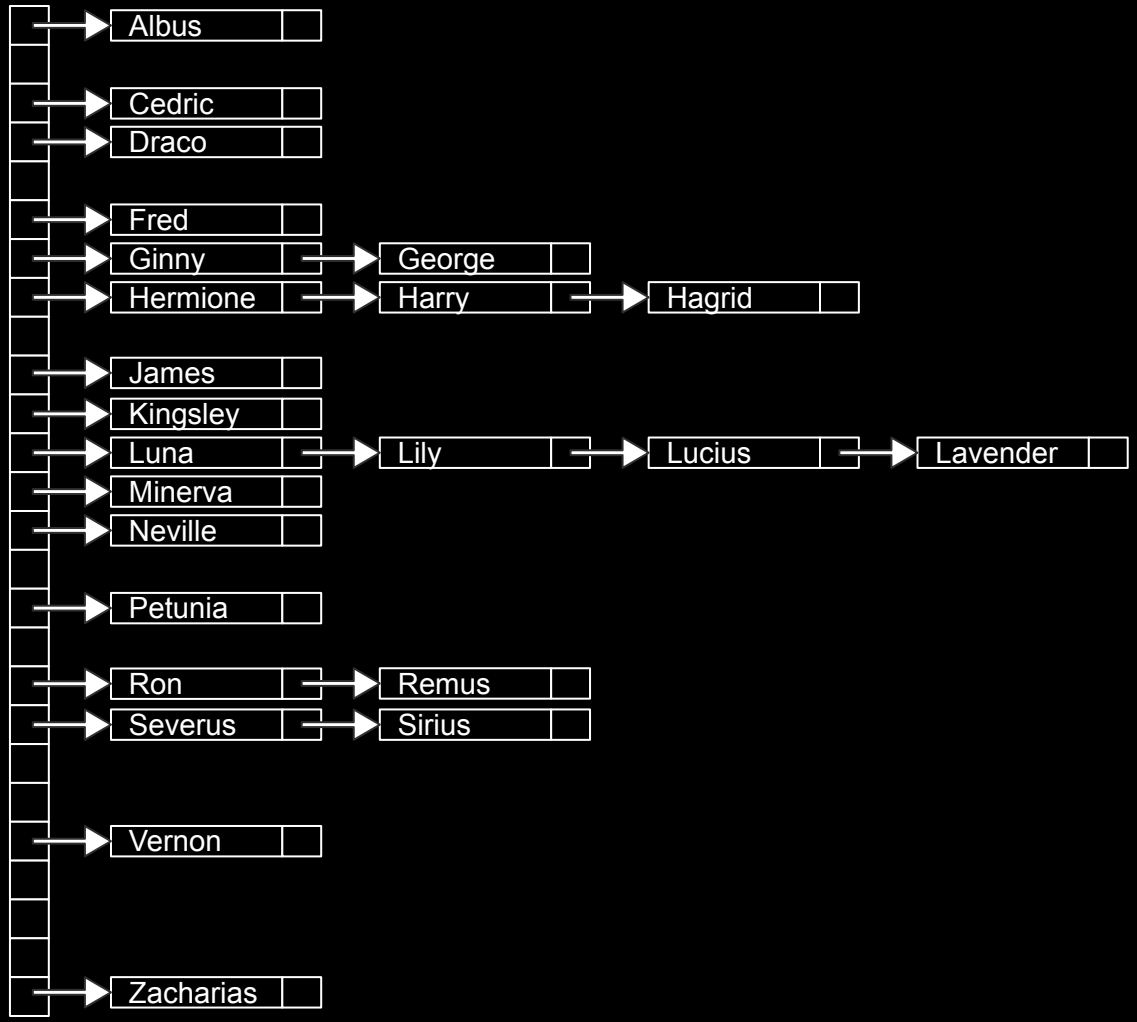
ruse
Helen Cho
Jonny Zhang
Abel
Sophie Edouard
Moni Radev
ehreteab
Joshua Ng
Montague Mawere

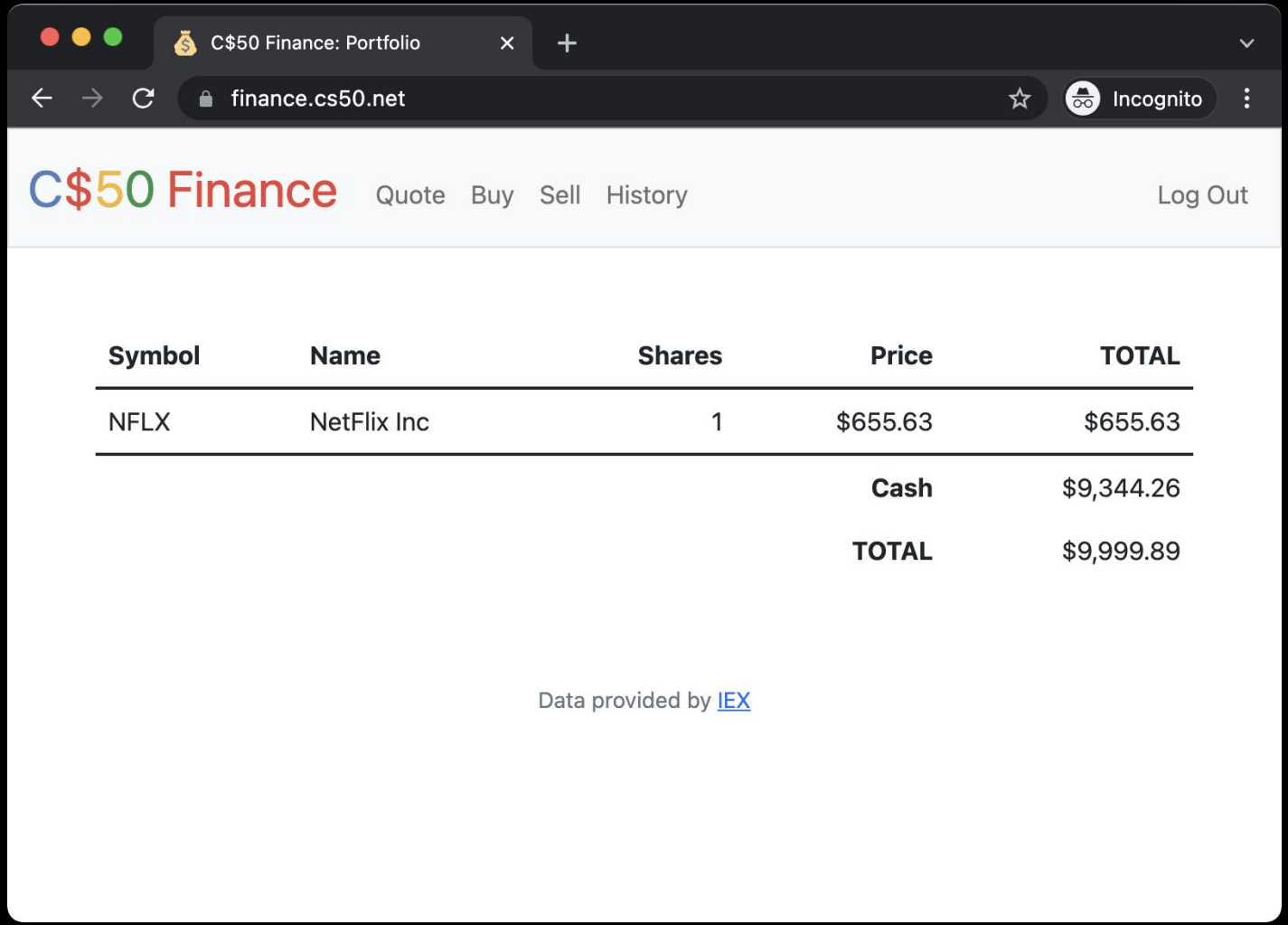
what ultimately matters in this course is not so much where you end up relative to your classmates but where you end up relative to yourself when you began

MARIO
000700
×01
WORLD
1-1
TIME
287

Mr. and Mrs. Dursley, of number four, Privet Drive, were proud to say that they were perfectly normal, thank you very much. They were the last people you'd expect to be involved in anything strange or mysterious, because they just didn't hold with such nonsense...

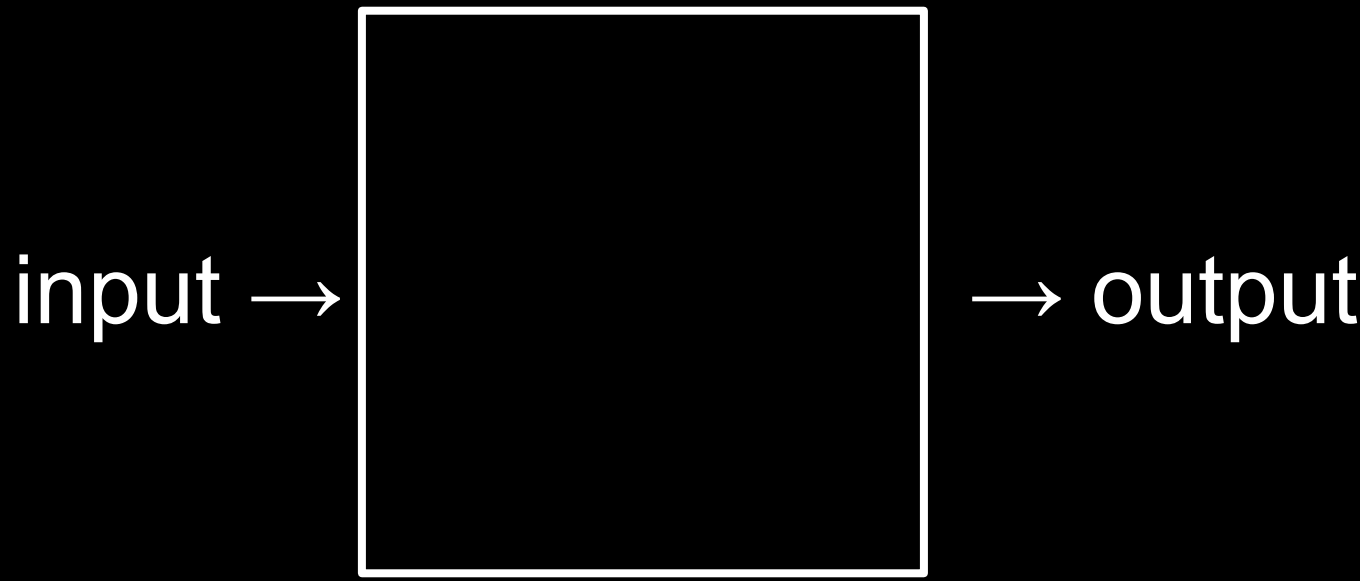
| Ballot | Ballot | Ballot | Ballot | Ballot |
| --- | --- | --- | --- | --- |
| 1. Alice | 1. Alice | 1. Bob | 1. Bob | 1. Charlie |
| 2. Bob | 2. Charlie | 2. Alice | 2. Alice | 2. Alice |
| 3. Charlie | 3. Bob | 3. Charlie | 3. Charlie | 3. Bob |


Albus
Cedric
Draco
Fred
Ginny
George
Hermione
Harry
Hagrid
James
Kingsley
Luna
Lily
Lucius
Lavender
Minerva
Neville
Petunia
Ron
Remus
Severus
Sirius
Vernon
Zacharias


C$50 Finance: Portfolio
finance.cs50.net
Incognito
C$50 Finance
Quote
Buy
Sell
History
Log Out
Symbol
Name
Shares
Price
TOTAL
NFLX
NetFlix Inc
1
$655.63
$655.63
Cash
$9,344.26
TOTAL
$9,999.89
Data provided by IEX

# computational thinking

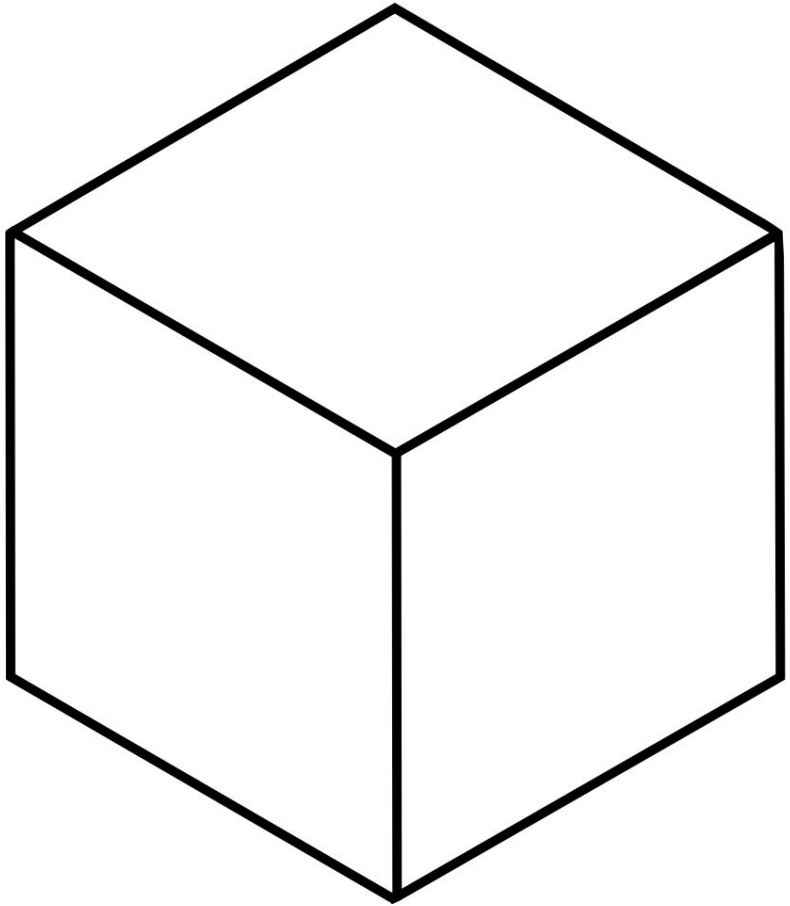
critical thinking

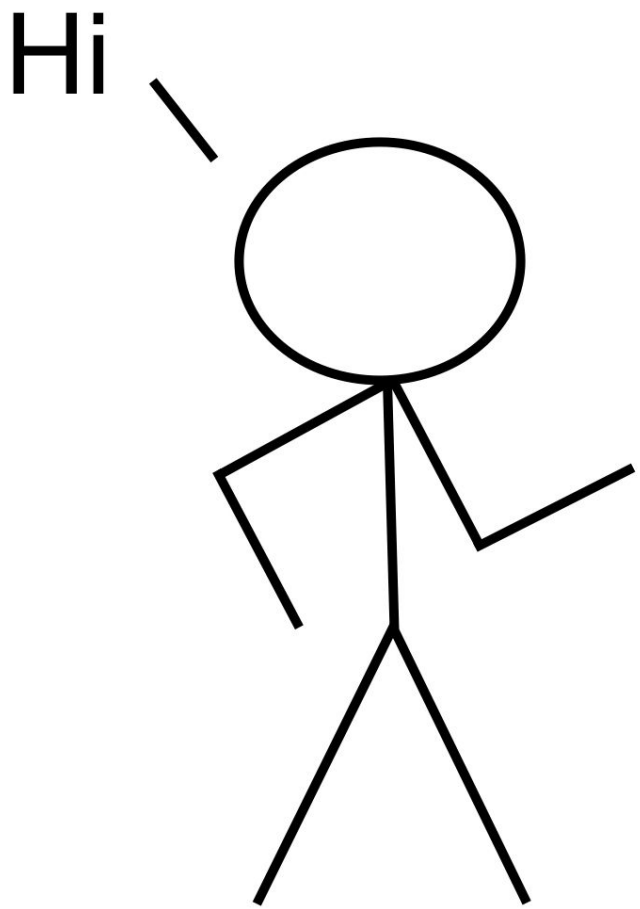

input →
→ output

correctness, design, style

abstraction

precision




Hi

# Install command-line tools

https://developer.apple.com/xcode/
https://docs.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://www.heroku.com/platform

...

# 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

I took CS50.
I took CS50.
I took CS50.
I took CS50.
I took CS50.
I took CS50.
I took CS50.
I took CS50.
I took CS50.
I took CS50.

# CS50 Quiz Show

11110000 10011111 10011000 10110111

Jennifer 8. Lee '99

# Jennifer 8. Lee '99

www.jennifer8lee.com

HIJAB emoji

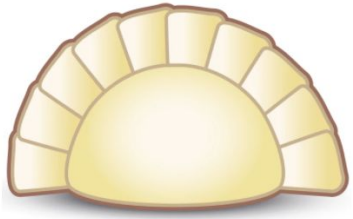
with Rayouf Alhumedhi

SAUNA emoji

with the Finnish government

RED ENVELOPE emoji

with Baidu



DUMPLING emoji

through Kickstarter

BROCCOLI emoji

with vegetarians

DNA emoji

with GE and the American Chemical Society

START
END

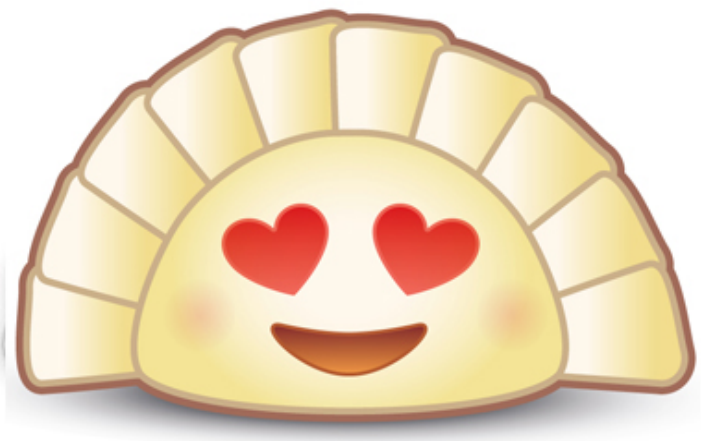
# How an Emoji Becomes an Emoji

Harvard CS50 • November 2021

Jennifer 8. Lee • Emojination

http:// twitter.com / yiyinglu

Messages (4)
Jennifer
Details
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?

UNICODE

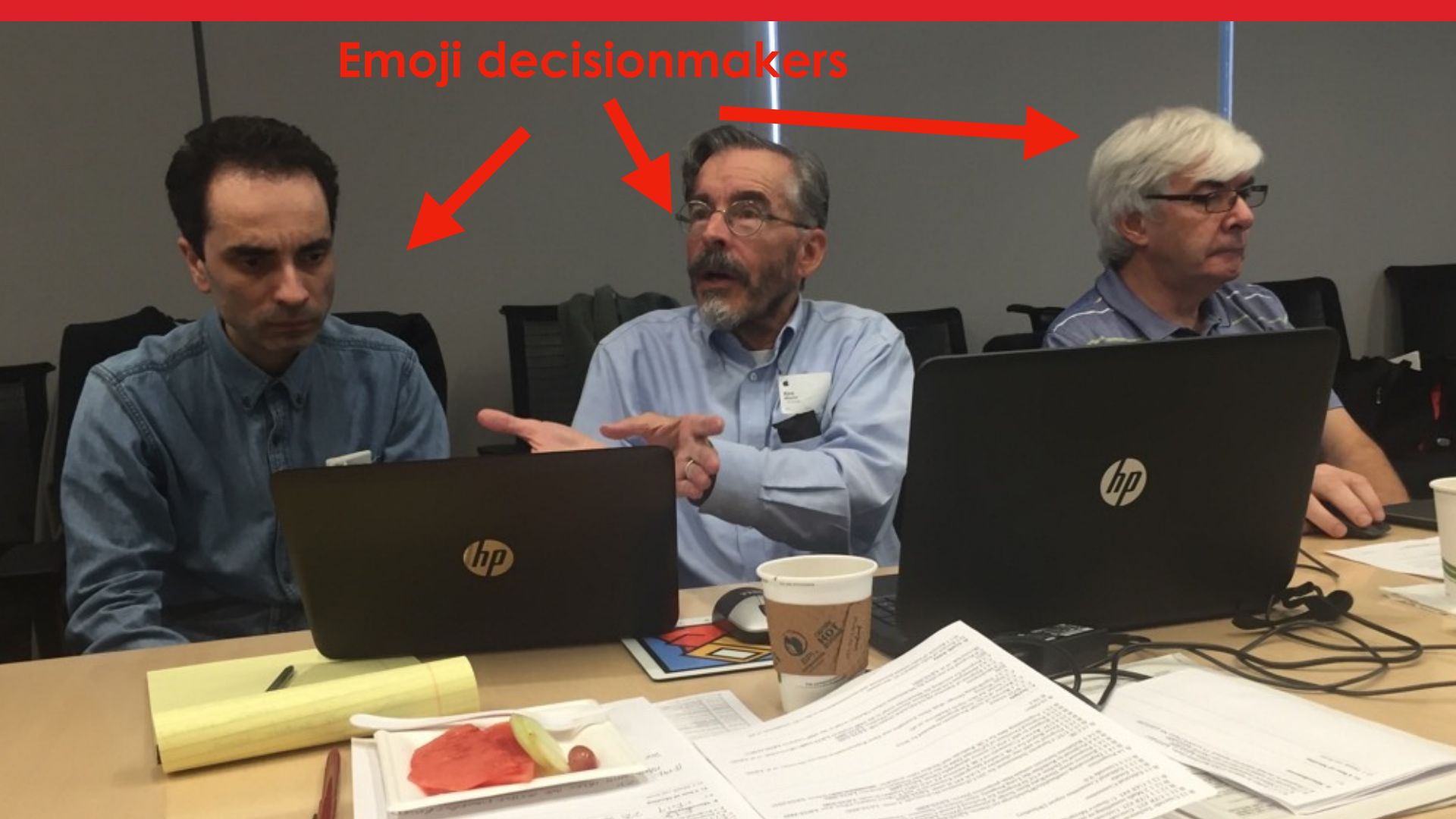
late 2015

SAP

# $18,000

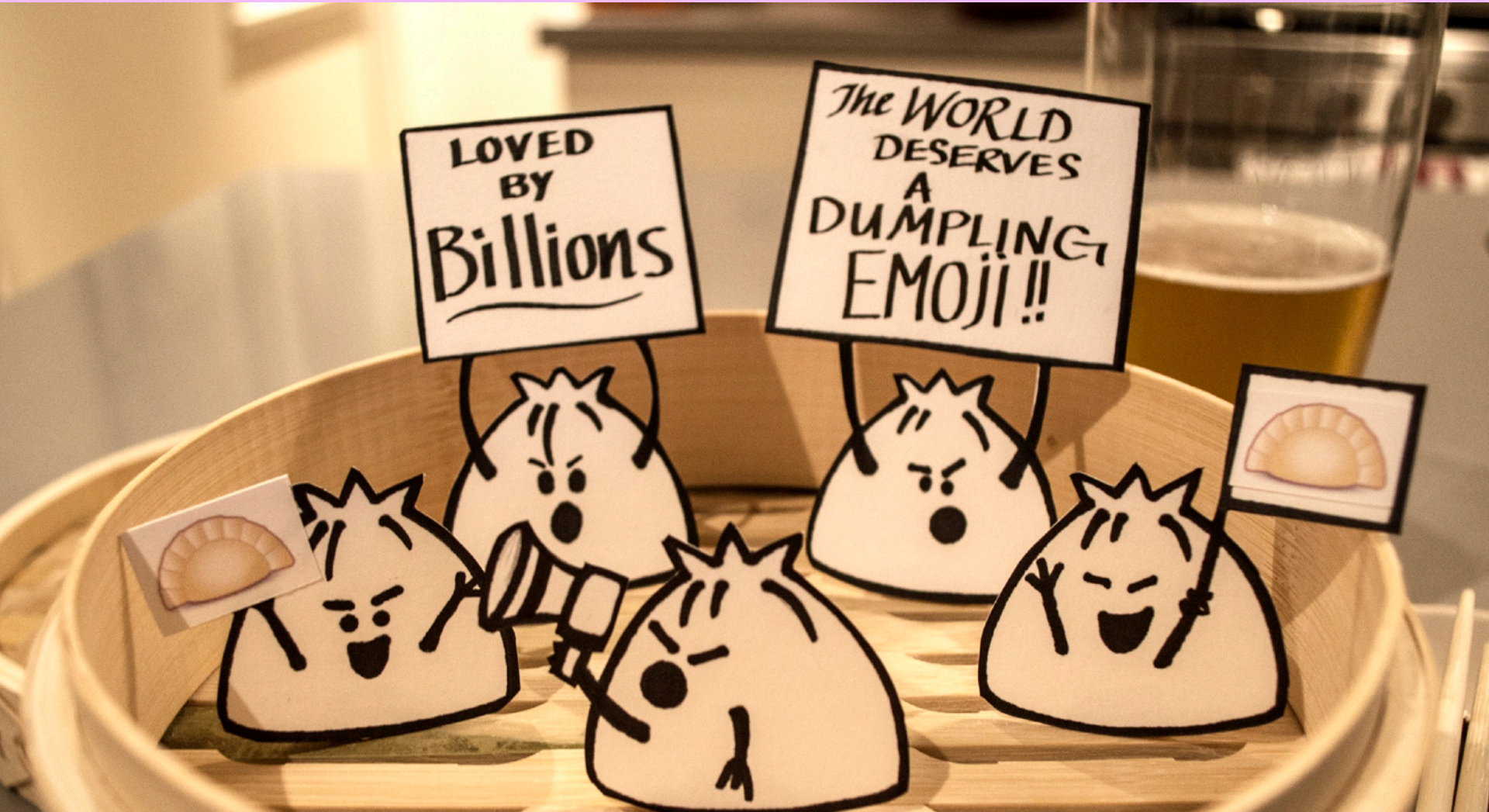
# $75.00

The room where it happens.


Emoji decisionmakers

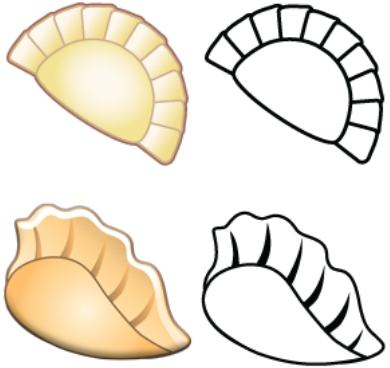
Shadowy
Emoji
Overlord

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

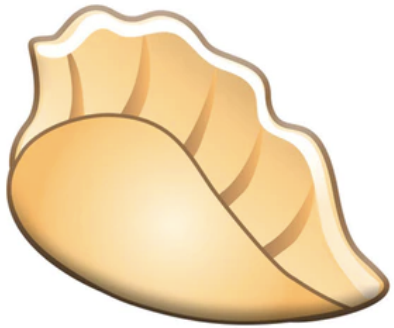
## Abstract

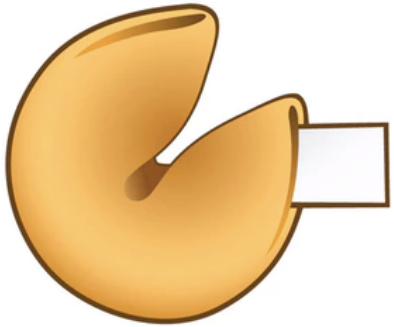
We are requesting the addition of a dumpling emoji, or more generally an emoji for “dough skin wrapped around a filling.” A dumpling glyph would fill a notable gap in the current emoji set and serve as a good “stem” emoji for related foods down the line. The formal name could be DUMPLING, with aliases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

- A section th e as to what degree eac
  - Some
  - Detail
- A set of ima e below under Images.

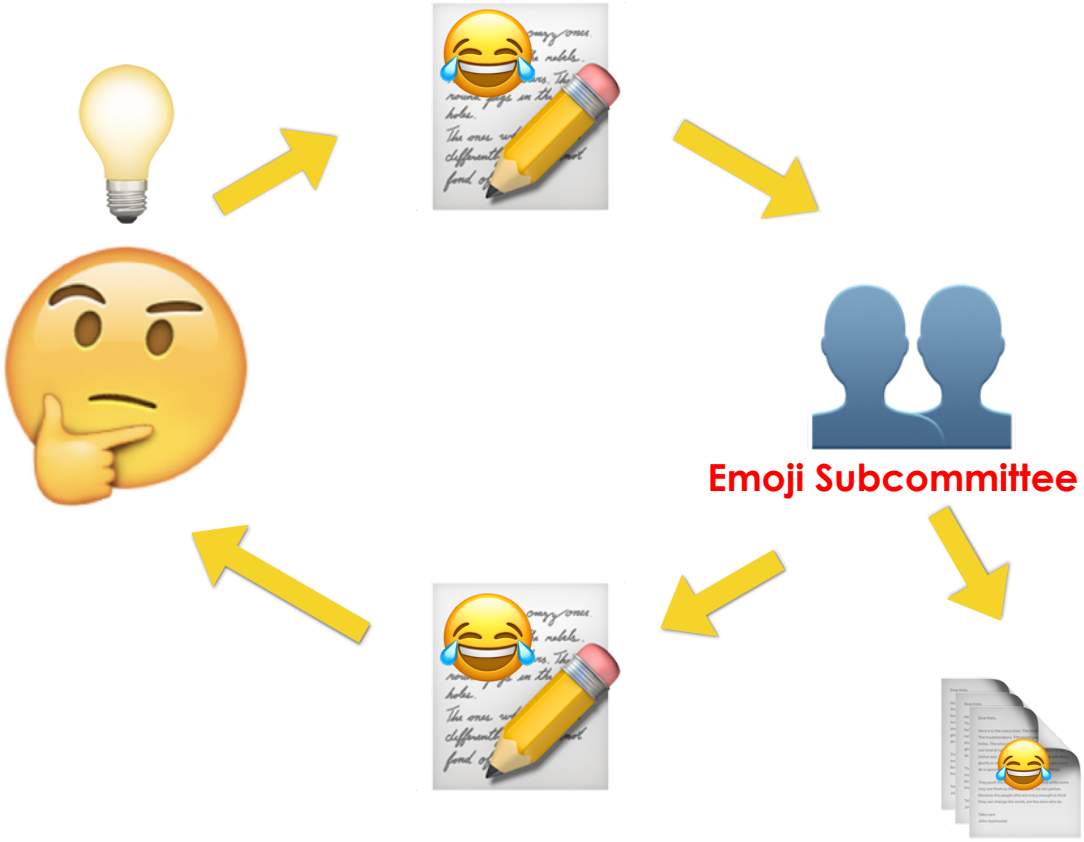
Some useful exa cific code points (U+XXXXX) for p cters was revised after can

---

## Selection Fac

Initially, the Unic e been broadened to inc possible new emoji. None of th ion. The most

START
END

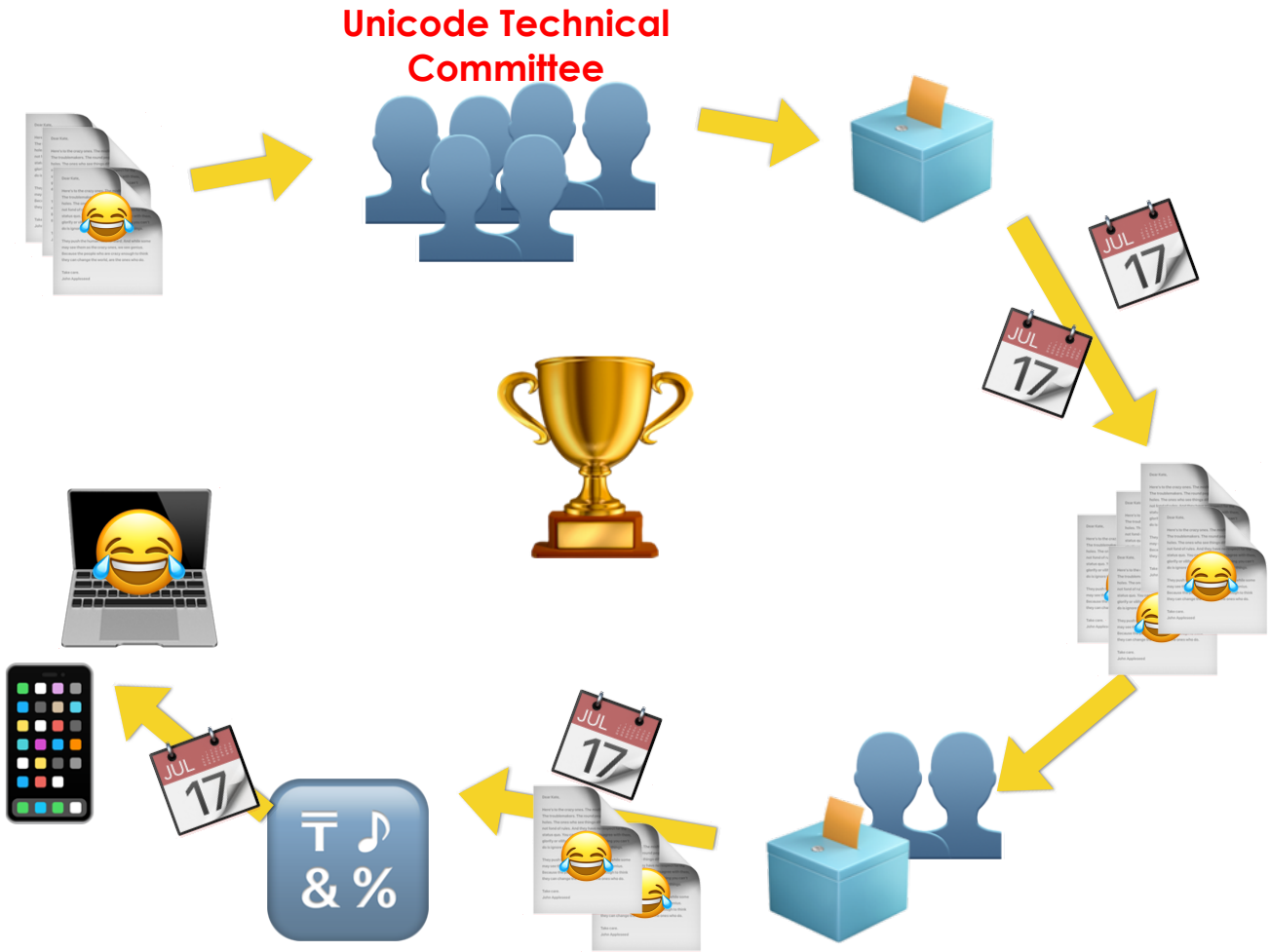

Emoji Subcommittee

# 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
JUL
17
JUL
17
JUL
17
JUL
17
&%

# 18-24 months

# EMOJI NATION

# Why does Unicode control emoji?

# 1999 • Docomo

Inbox:
New Acquisitions
The Original Emoji
by Shigetaka Kurita
222
!
!?
!!
BK
ATM
CVS
GS
FAX
SOON
ON!
END

# 2007

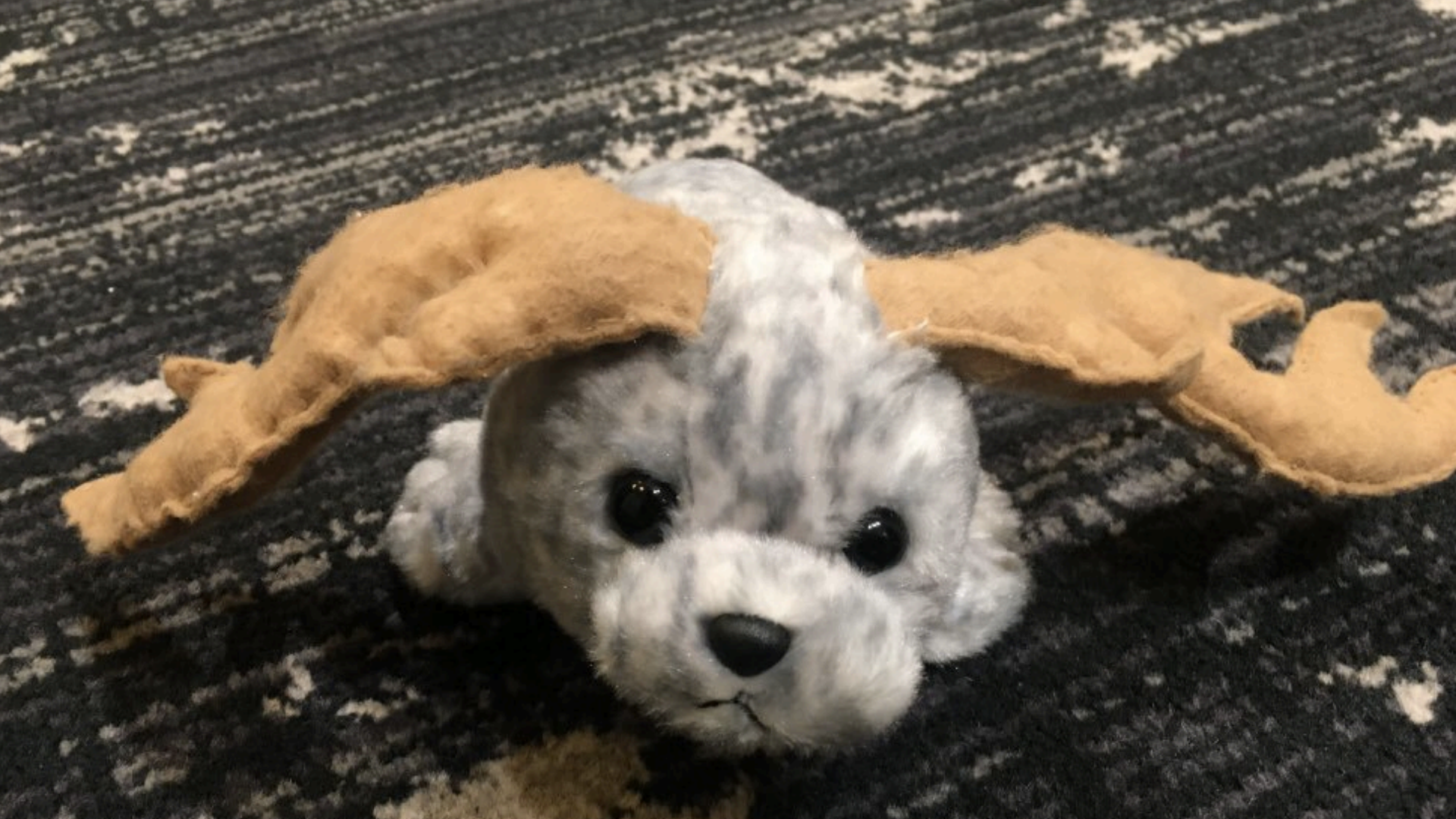
Enable everybody, speaking every language on the Earth, to be able to use their language on computer and smartphones.

# Three main projects

- Encoding characters (including emoji!) — now over 100,000

- Localization Resources
(Common Locale Data Repository, “CLDR")

- Programming Libraries
(International Components for Unicode, “ICU”)



# SEALDEER = CLDR

# SEALDEER ???

# 2010 • Unicode 6.0

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

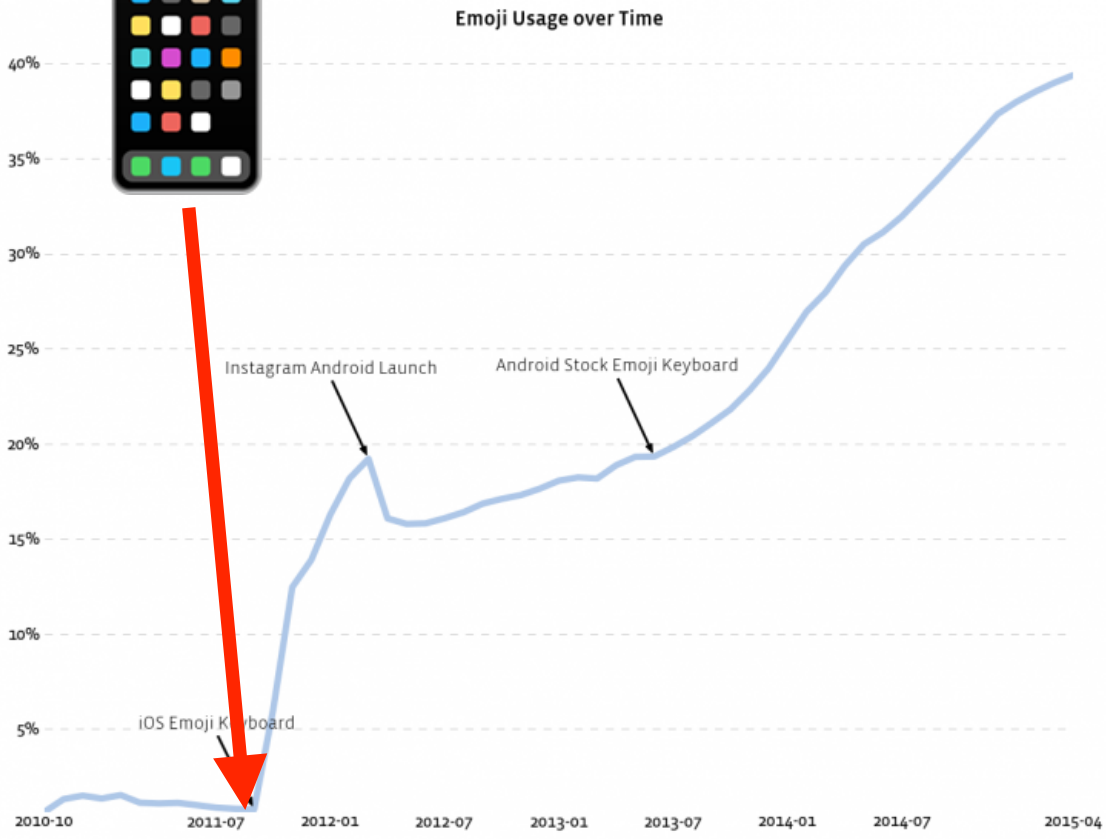
U+1F602

128514

1111101100000010

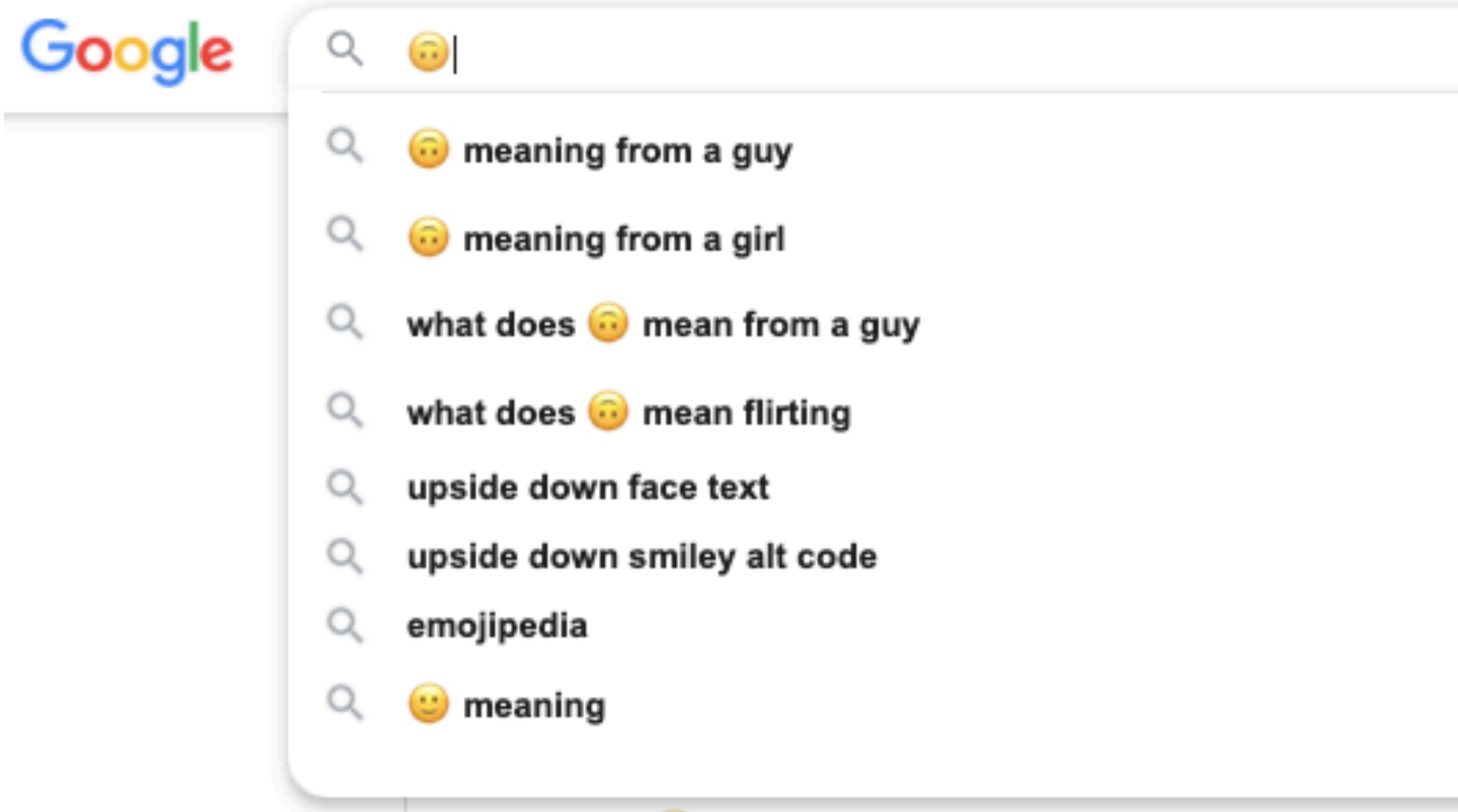
# 2011

# 2011


Emoji Usage over Time
40%
35%
30%
25%
20%
15%
10%
5%
Instagram Android Launch
Android Stock Emoji Keyboard
iOS Emoji Keyboard
2010-10
2011-07
2012-01
2012-07
2013-01
2013-07
2014-01
2014-07
2015-04

# What does

# emoji mean?


Google
🙃
🙃 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

# 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.

#EmojiDelMate
2019

PLAN
INTERNATIONAL

APPLE

Women

# Proposal to Add Emoji: Face With One Eyebrow Raised

Maximilian Merz, unicode@mxmerz.de

November 5, 2015

**Abstract**

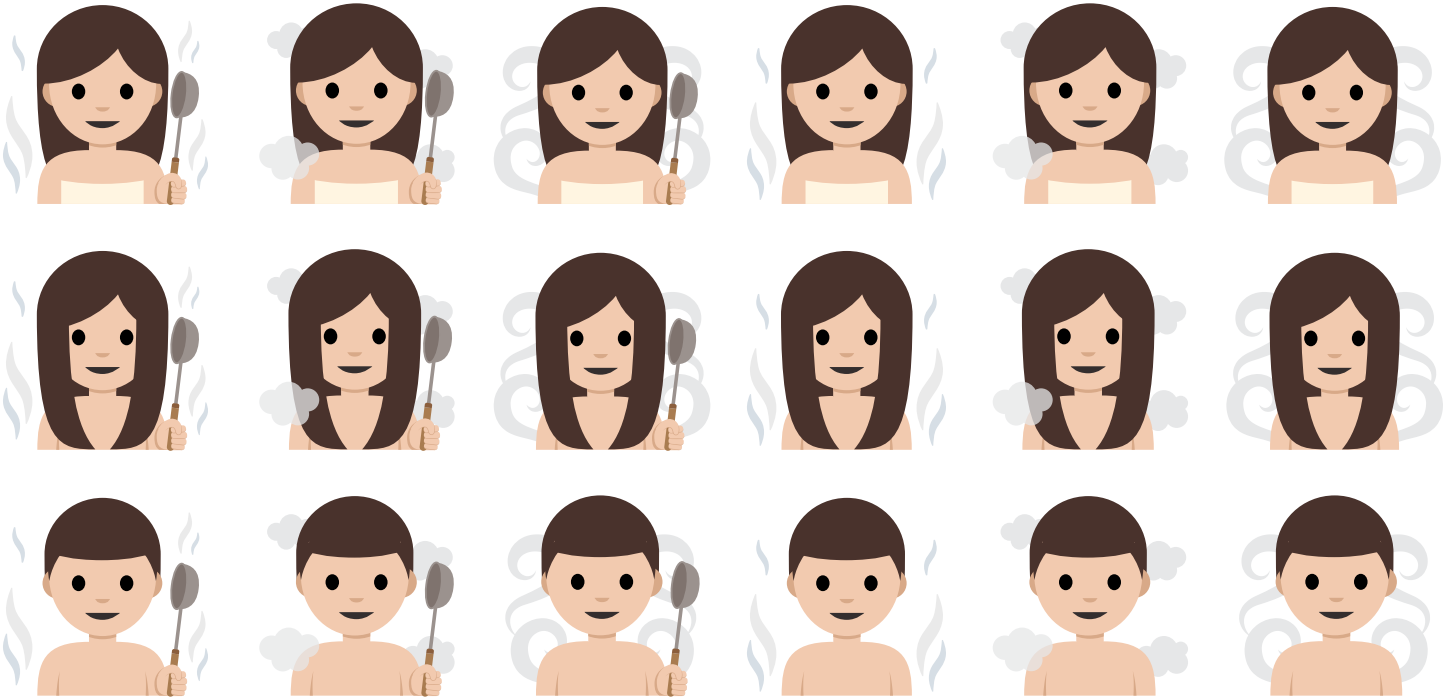
Currently, there is no emoji encoded in Unicode that shows a face with one raised eyebrow. A raised eyebrow is a widely used facial expression and equally widely recognized as conveying a variety of meanings, centered around scepticism, surprise, disagreement, and being impressed. This proposal presents 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.

*Art created by Bruno Leo Ribeiro*

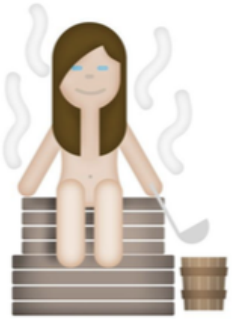
**Sauna Emojis Submission**
To: Unicode Consortium
From: Ministry for Foreign Affairs of Finland (co-ordinator Petra Theman, Director of Public Diplomacy)
Date: 13.05.2016

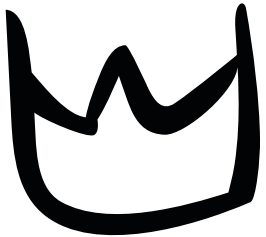
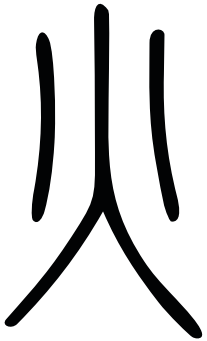
**Abstract**

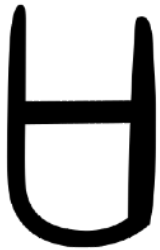
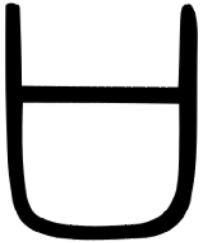
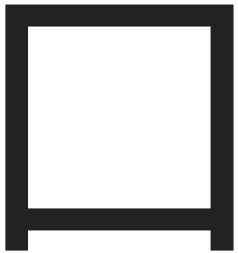
We are requesting the addition of the sauna emojis, both male and female person going into sauna. The sauna emojis would fill a notable gap in the current emoji set and serve as an important addition to activity, people and location emojis. The formal names could be SAUNA MAN and SAUNA WOMAN.

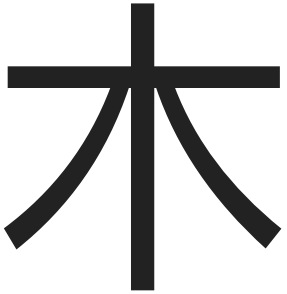


# Person in Steamy Room

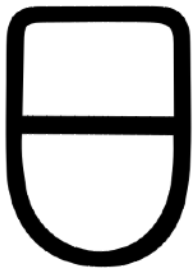
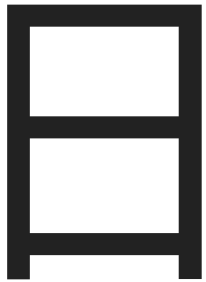


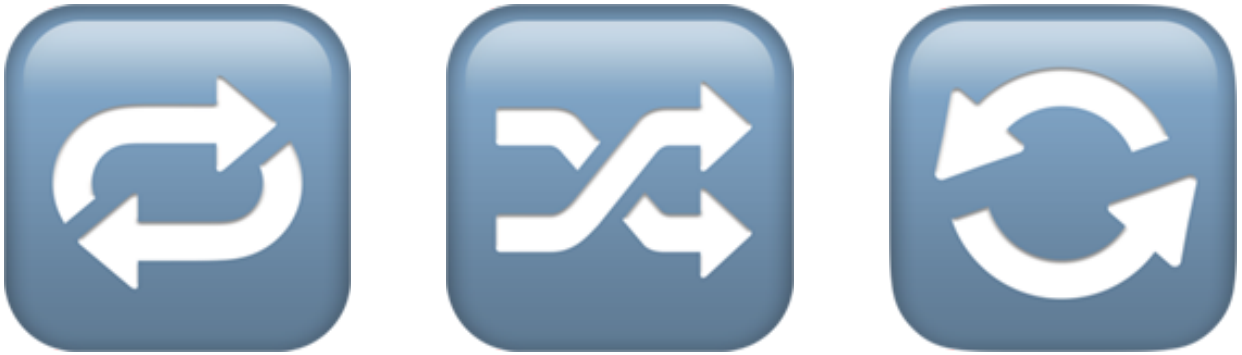





月



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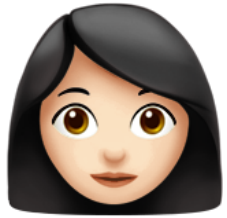
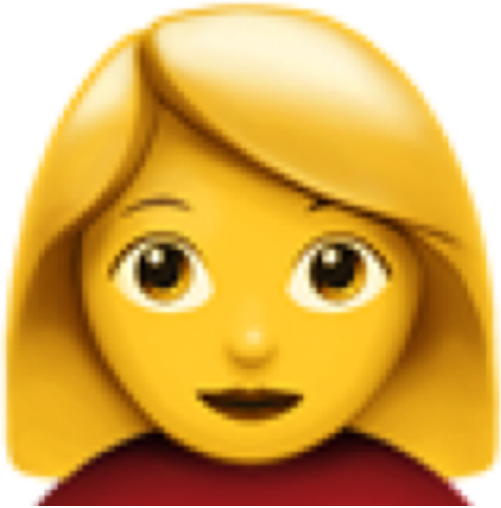
安 宀 女 

安

女



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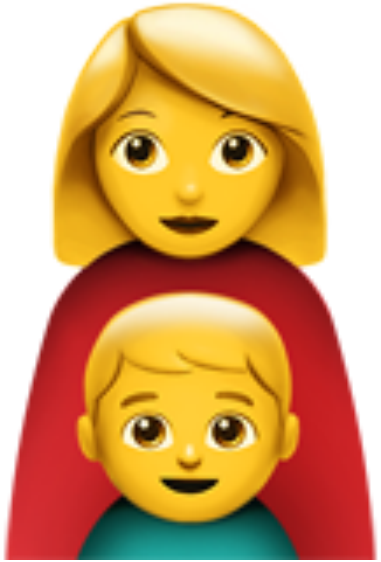
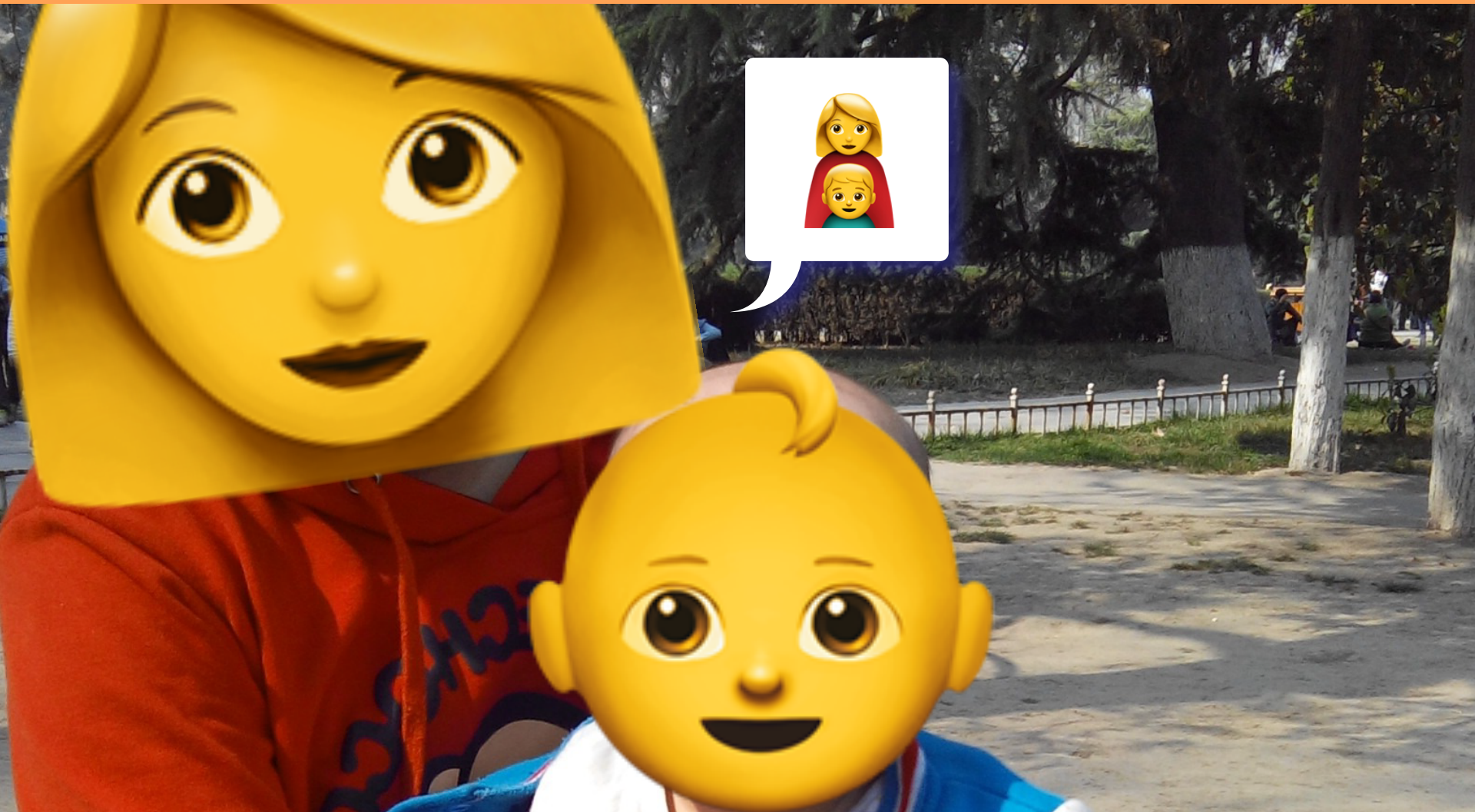


# 好



姦

# 婪

奴

嫉

奸

# THE HANMOJI HANDBOOK

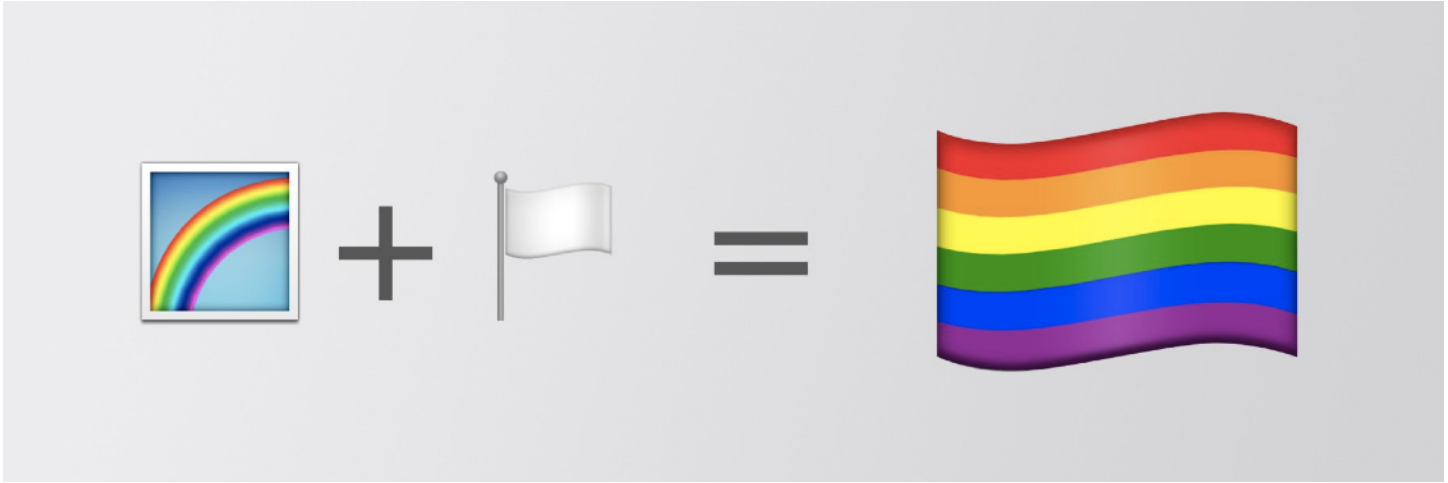
## YOUR GUIDE TO THE CHINESE LANGUAGE THROUGH EMOJI

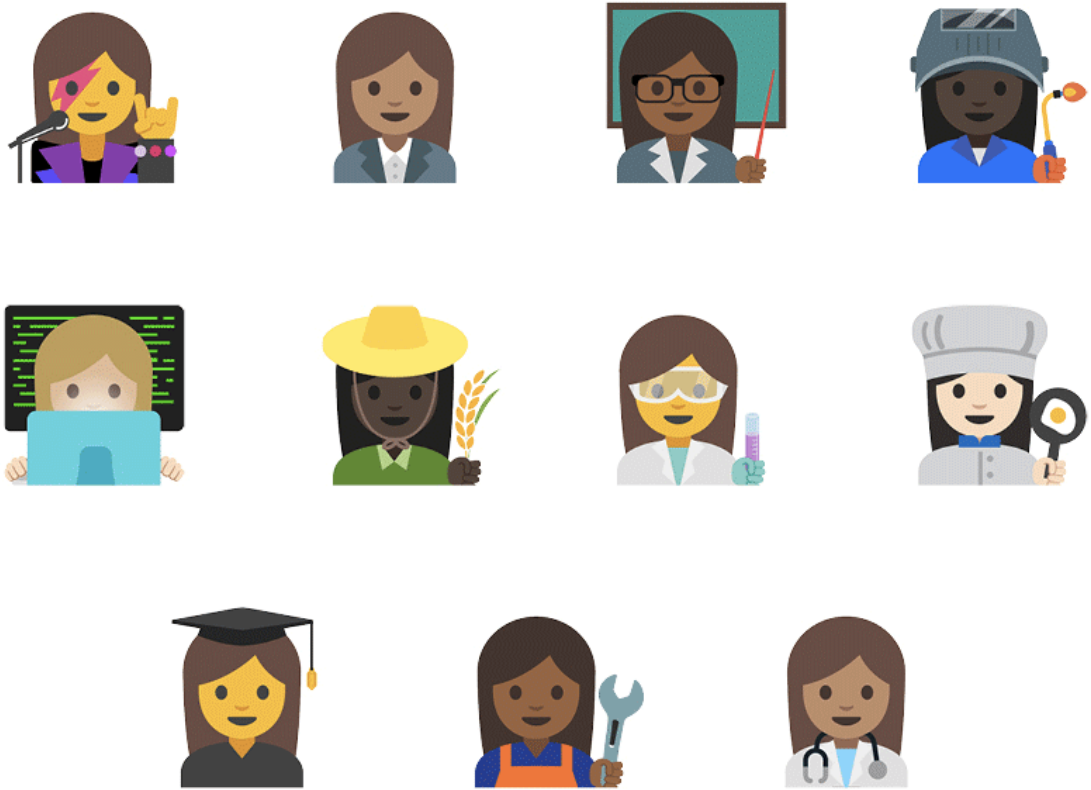
Jason Li, An Xiao Mina, and Jennifer 8. Lee

MiTeenPress

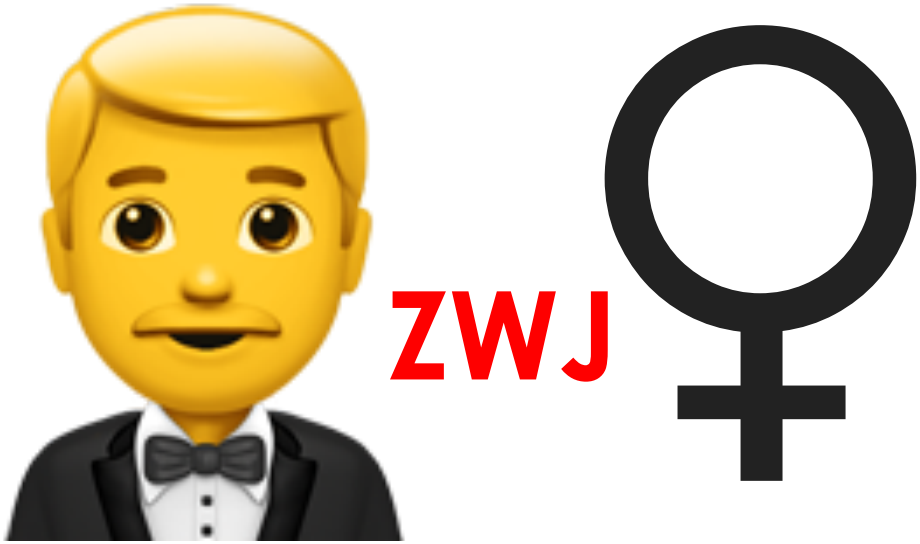
# The Power of Combining Emoji

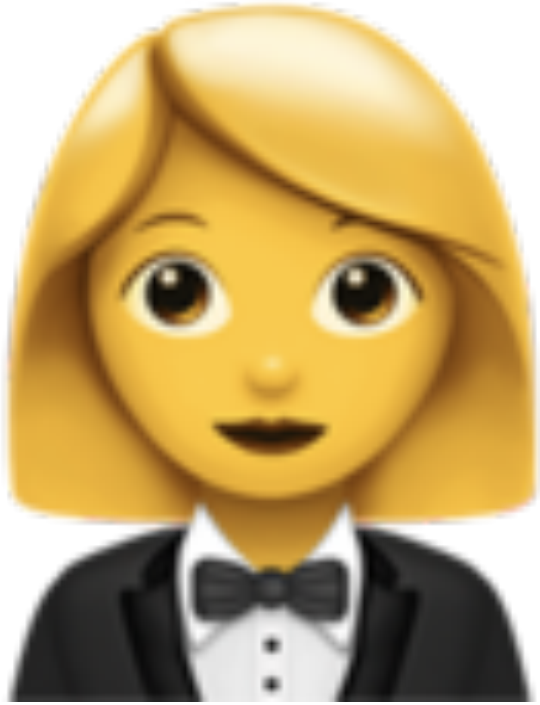
# “ZWJ”

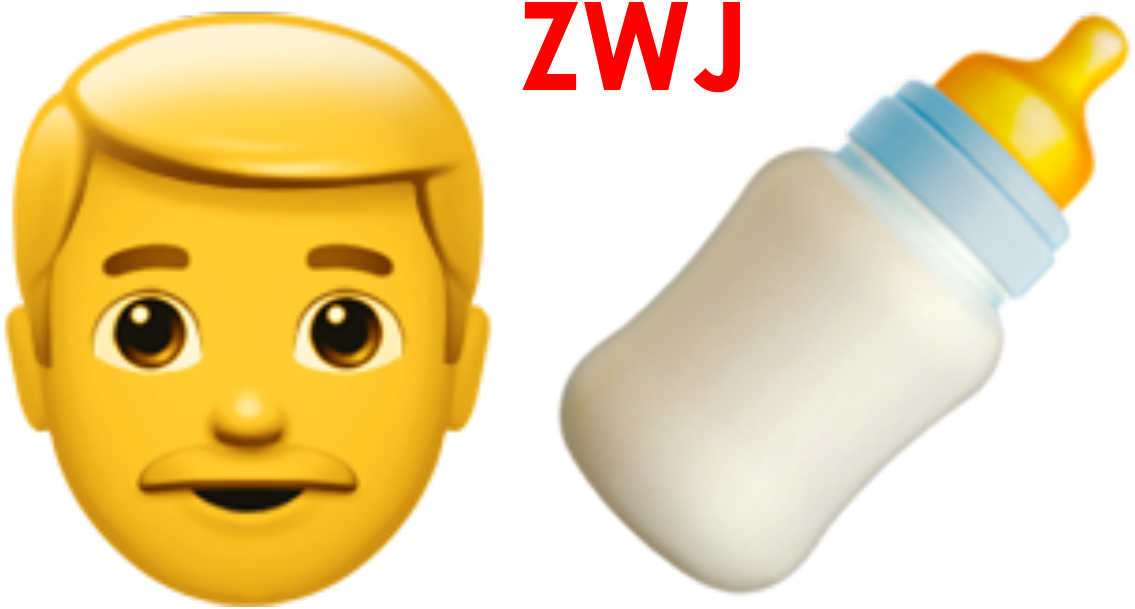




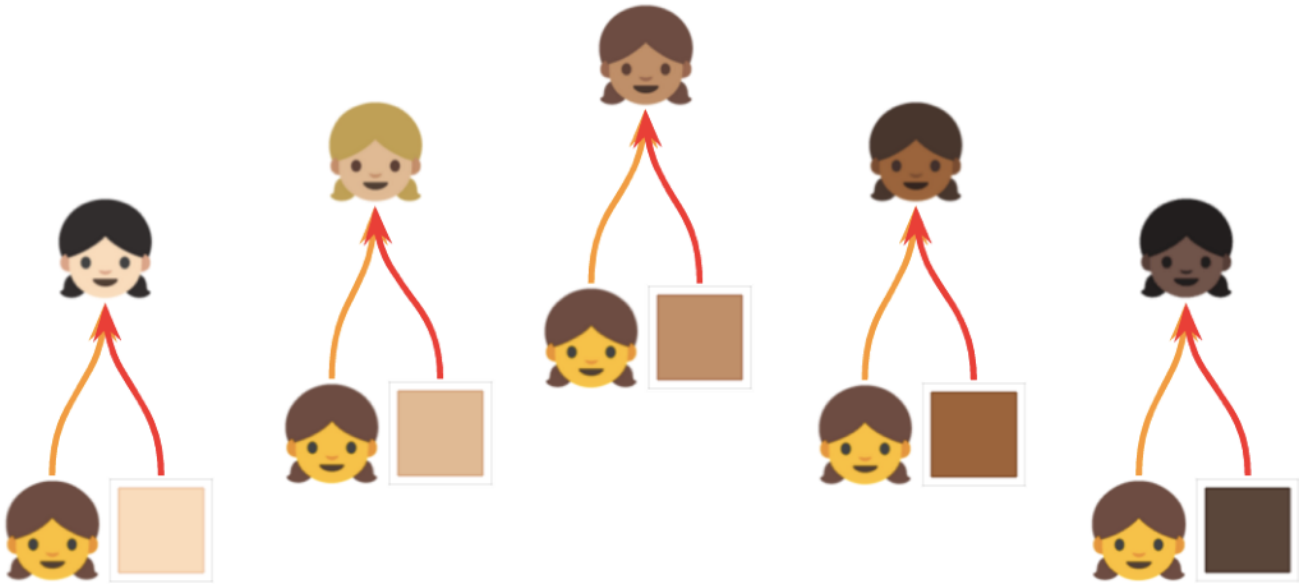
| | | | |
|---|---|---|---|
| Farming | | **Woman:**<br>[U+1F469] + [U+1F69C]<br><br>**Man:**<br>[U+1F468] + [U+1F69C] | Farmer |
| Food service | | **Woman:**<br>[U+1F469] + [U+1F373]<br><br>**Man:**<br>[U+1F468] + [U+1F373] | Chef, cook |
| Education | | **Woman:**<br>[U+1F469] + [U+1F3EB]<br><br>**Man:**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

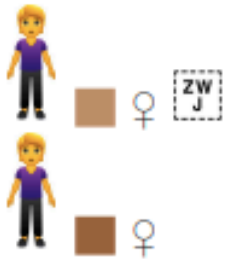

ZWJ



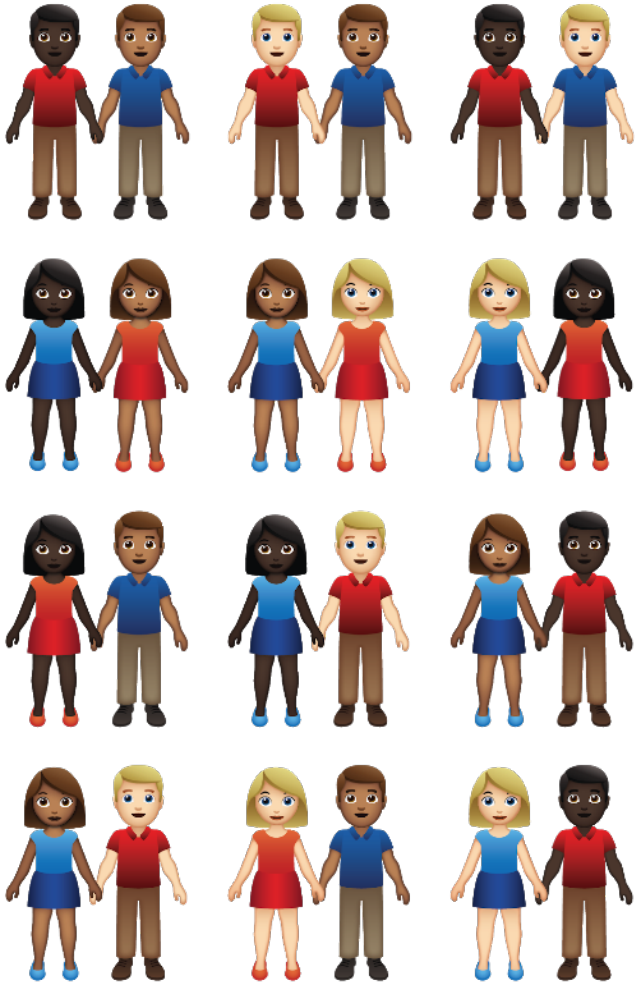

ZWJ

# Skin Tones



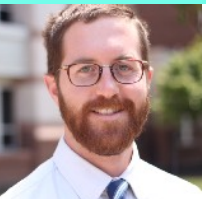
| | | | |
|---|---|---|---|
| 36 | X1F9CD 1F3FD 200D 2640 FE0F 200D X1F9CD 1F3FE 200D 2640 FE0F |  | STANDING WOMAN, MEDIUM SKIN TONE; ZWJ; STANDING WOMAN, MEDIUM-DARK SKIN TONE. |
| 37 | X1F9CD 1F3FD 200D 2640 FE0F 200D X1F9CD 1F3FF 200D 2640 FE0F | | STANDING WOMAN, MEDIUM SKIN TONE; ZWJ; STANDING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

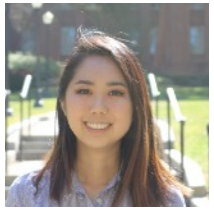
tinder

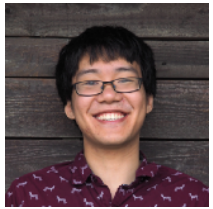


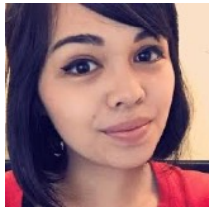
ABC

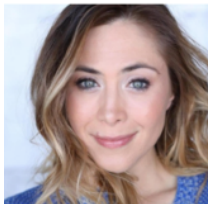
# Emojination Emoji

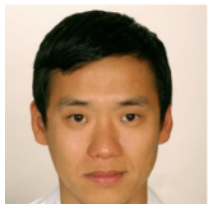






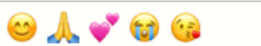
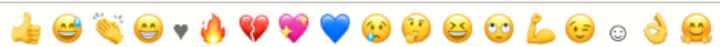
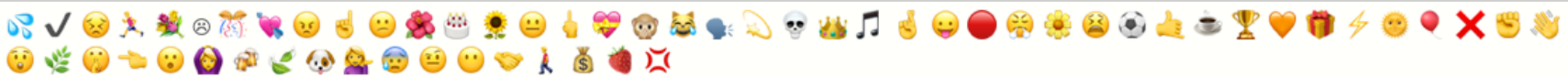
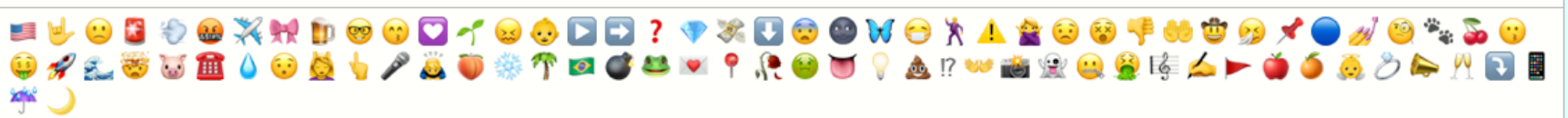
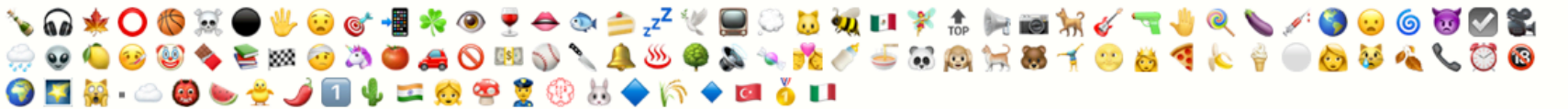


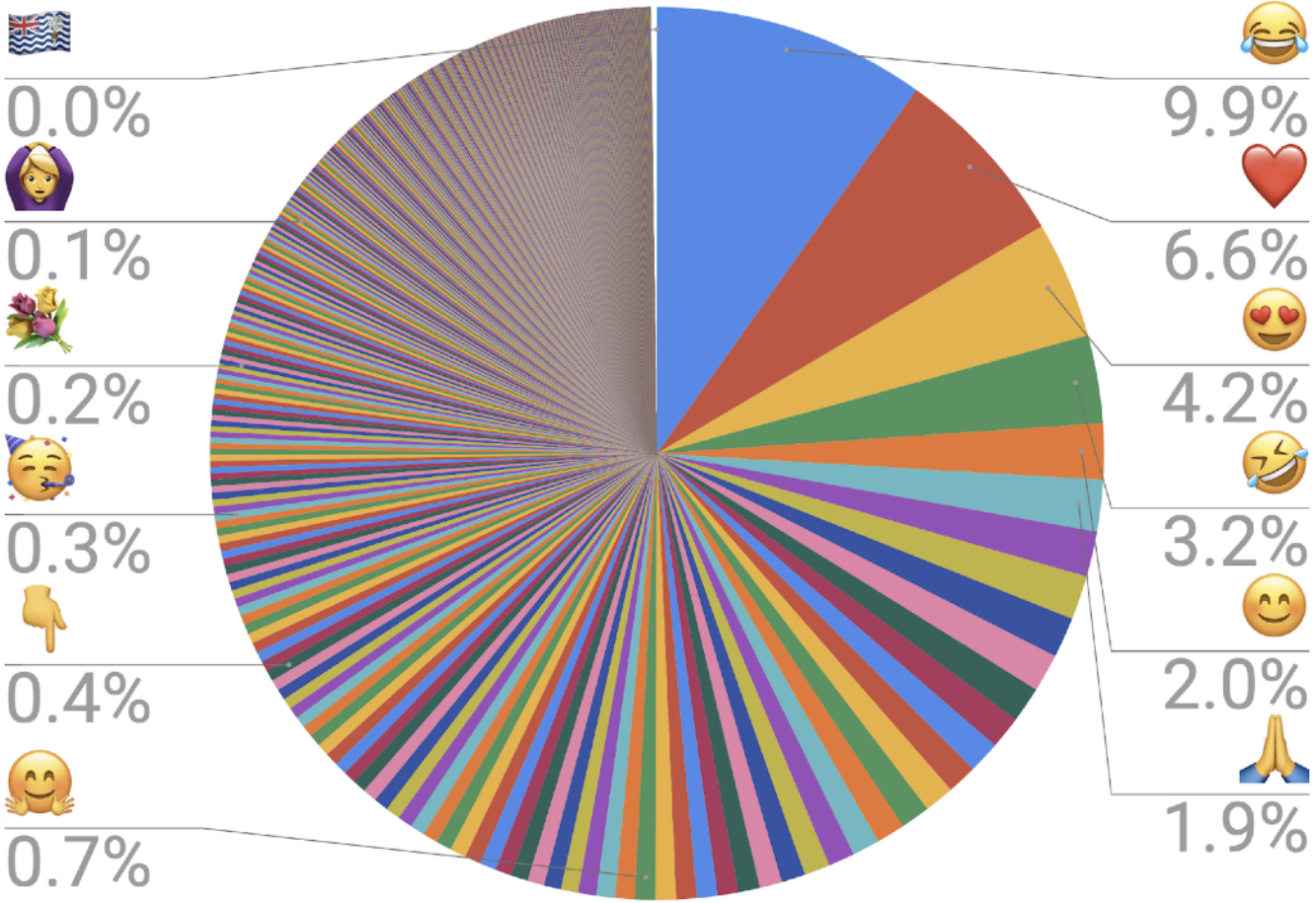


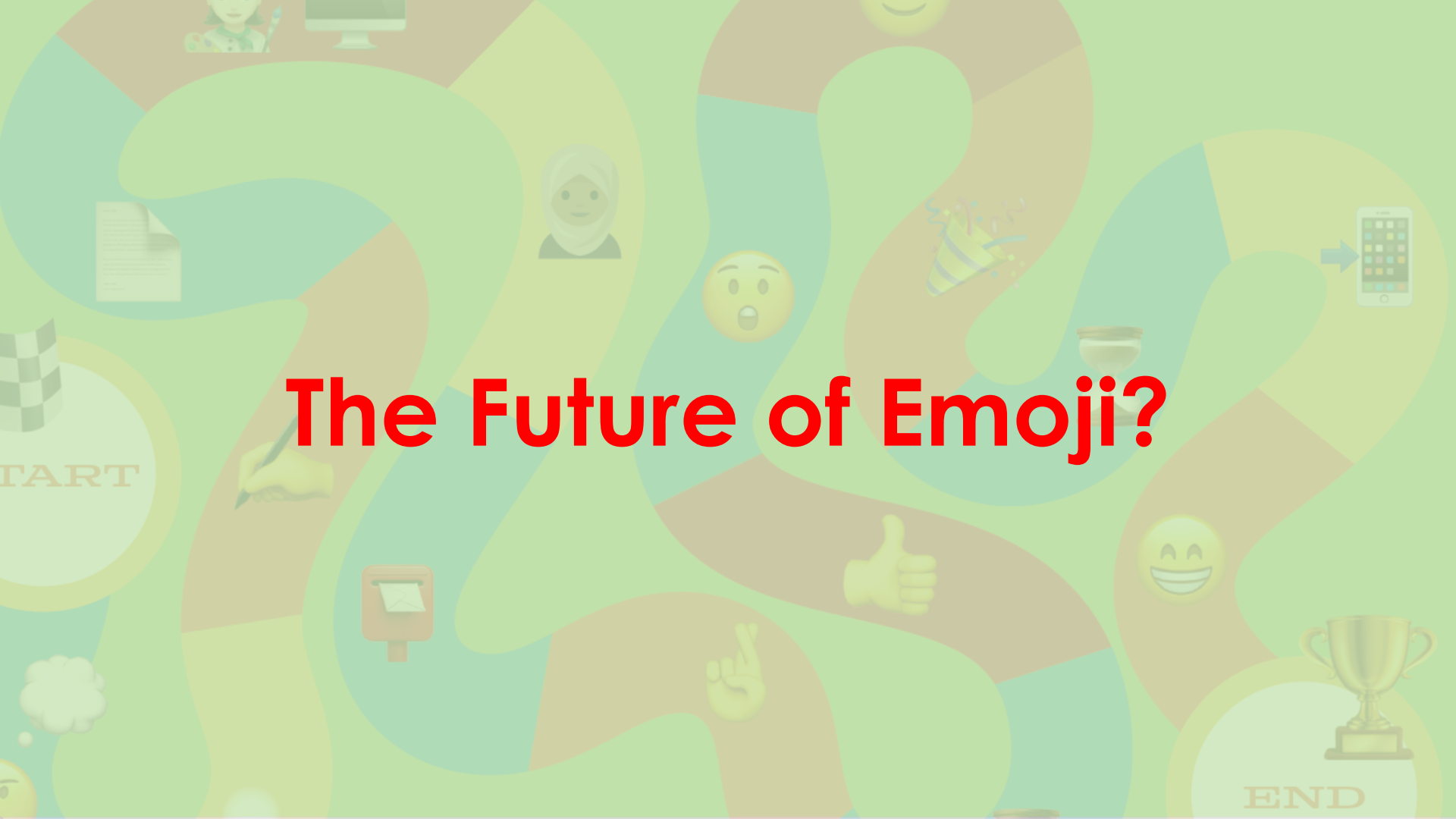


# Frequency of Emoji Use.

Ranked Order by Median Frequency

| | |
|---|---|
| 0 | |
| 1 | |
| 2 |  |
| 3 |  |
| 4 | |
| 5 | |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 | |


0.0%
0.1%
0.2%
0.3%
0.4%
0.7%
9.9%
6.6%
4.2%
3.2%
2.0%
1.9%


The Future of Emoji?

B <: A
A
<: A
B <: D
A → B <: C → D
C → B

# Coded Hashes of Arbitrary Images

(or: the last frontier of emoji encoding)

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2016-05-02
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## 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

| № | 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

| № | 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

| № | IMAGE | CLDR SHORT NAME | CLDR KEYWORDS | Proposal | Additional |
|---|---|---|---|---|---|
| 9 | | HYACINTH | flower, nowruz, haftsin, haftseen, purple, lavender, bluebonnet, lupine, snapdragon | L2/21-215 | 0 |

### animal-marine

| | | | | | |
|---|---|---|---|---|---|
| 10 | | JELLYFISH | marine, invertebrate, jelly, stinger, burn, ouch | L2/21-217 | 0 |

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

## Food & Drink

### food-vegetable

| № | 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 |

| № | IMAGE | CLDR SHORT NAME | CLDR KEYWORDS | Proposal | Additional Seque |
|---|---|---|---|---|---|
| 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

| № | 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

| № | 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 |

# emojination.org

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jenny@emojination.org

# Question: What is Unicode?

# This was CS50