The Fourteenth Annual
North American Computational Linguistics
Open Competition 2020
www.nacloweb.org

Open Round
January 23, 2020

Serious language puzzles that are surprisingly fun!
-Will Shortz, Crossword editor of The New York Times and Puzzlemaster for NPR
Welcome to the fourteenth annual North American Computational Linguistics Open Competition! You are among the few, the brave, and the brilliant to participate in this unique event. In order to be completely fair to all participants across North America, we need you to read, understand, and follow these rules completely.

Rules

1. The contest is three hours long and includes eight problems, labeled A to H.
2. Follow the facilitators’ instructions carefully.
3. If you want clarification on any of the problems, talk to a facilitator. The facilitator will consult with the jury before answering.
4. You may not discuss the problems with anyone except as described in items 3 & 11.
5. Each problem is worth a specified number of points, with a total of 100 points.
   In this year’s open round, no points will be given for explanations. Instead, make sure to fill out all the answer boxes properly.
6. All your answers should be in the Answer Sheets at the end of this booklet. ONLY THE ANSWER SHEETS WILL BE GRADED.
7. Write your name and registration number on each page of the Answer Sheets.
   Here is an example: Jessica Sawyer #850
8. The top 10% of participants (approximately) across the United States and Anglophone Canada in the open round will be invited to the second round.
9. Some problems are more difficult than others, but all can be solved using ordinary reasoning and some basic analytic skills. You don’t need to know anything about linguistics or about these languages in order to solve them.
10. If we have done our job well, very few people will solve all these problems completely in the time allotted. So, don’t be discouraged if you don’t finish everything.
11. **DO NOT DISCUSS THE PROBLEMS UNTIL THEY HAVE BEEN POSTED ONLINE! THIS MAY BE A COUPLE OF MONTHS AFTER THE END OF THE CONTEST.**

Oh, and have fun!
NACLO 2020 Organizers

Program Committee:
Adam Hesterberg — Massachusetts Institute of Technology
Aleka Blackwell — Middle Tennessee State University
Ali Sharman — University of Michigan
Andrés Salanova — University of Ottawa
Annie Zhu — Harvard University
Babette Verhoeven — Aquinas College
Ben LaFond — Harvard University
Corinne Soucy — Université de Montréal
Daniel Lovsted — McGill University
David Mortensen — Carnegie Mellon University
Dick Hudson — University College London
Dragomir Radev — Yale University
Elisabeth Mayer — Australian National University
Ethan Chi — Stanford University
Harold Somers — All Ireland Linguistics Olympiad
Heather Newell — UQAM
James Pustejovsky — Brandeis University
James Hyett — University of Toronto
Ji Hun Wang — Stanford University
Kevin Liang — University of Pennsylvania
Lori Levin — Carnegie Mellon University
Margarita Misirpashayeva — Massachusetts Institute of Technology
Mary Laughren — University of Queensland
Matthew Gardner — Carnegie Mellon University
Mihir Singhal — Massachusetts Institute of Technology
Oliver Sayeed — University of Pennsylvania
Patrick Littell — University of British Columbia
Pranav Krishna — Massachusetts Institute of Technology
Shuli Jones — Massachusetts Institute of Technology
Sonia Reilly — Massachusetts Institute of Technology
Tom Roberts — University of California, Santa Cruz
NACLO 2020 Organizers

Problem Credits:
Problem A: Kevin Liang  
Problem B: Aleka Blackwell  
Problem C: Ethan Chi  
Problem D: Ethan Chi  
Problem E: Michael Salter  
Problem F: Sam Ahmed  
Problem G: Tom McCoy  
Problem H: Michael Salter

Organizing Committee:
Adam Hesterberg — Massachusetts Institute of Technology  
Aleka Blackwell — Middle Tennessee State University  
Ali Sharman — University of Michigan  
Andrés Salanova — University of Ottawa  
Annie Zhu — Harvard University  
Ben LaFond — Harvard University  
Brian Xiao — Massachusetts Institute of Technology  
Corinne Soucy — Université de Montréal  
Daniel Lovsted — McGill University  
David Mortensen — Carnegie Mellon University  
Dragomir Radev — Yale University  
Ethan Chi — Stanford University  
James Pustejovsky — Brandeis University  
Ji Hun Wang — Stanford University  
Kevin Liang — University of Pennsylvania  
Lori Levin — Carnegie Mellon University  
Margarita Misirpashayeva — Massachusetts Institute of Technology  
Matthew Gardner — Carnegie Mellon University  
Mihir Singhal — Massachusetts Institute of Technology  
Patrick Littell — University of British Columbia  
Pranav Krishna — Massachusetts Institute of Technology  
Ryan Guan — Stanford University  
Shuli Jones — Massachusetts Institute of Technology  
Sonia Reilly — Massachusetts Institute of Technology  
Tom Roberts — University of California, Santa Cruz
NACLO 2020 Organizers (cont’d)

US Team Coaches:
Aleka Blackwell, Middle Tennessee State University
Dragomir Radev, Yale University
Lori Levin, Carnegie Mellon University

Canadian Coordinators and Team Coaches:
Daniel Lovsted, McGill University

USA Contest Site Coordinators:
Austin Math Circle: Joshua Dever
Brandeis University: James Pustejovsky, Sarah Irwin, Nikhil Krishnaswamy
Brigham Young University: Deryle Lonsdale
California State University: Michael Ahland
Carnegie Mellon University: Mary Jo Bensasi, Lori Levin
College of William and Mary: Dan Parker
Columbia University: Kathy McKeown, Brianne Cortese, Smaranda Muresan
Cornell University: Abby Cohn, Sam Tilsen
Emory University: Jinho Choi, Phillip Wolff
Georgetown University: Emma Manning
Indiana University: Sandra Kuebler
Johns Hopkins University: Rebecca Knowles, Pamela Shapiro, Tom McCoy
Kansas State University: Natasha Rojkovskaia
Keiser University, Jacksonville: Deborah Williams
Long Island University Post: Rachel Szekely
Massachusetts Institute of Technology: Margarita Misirpashayeva, Sonia Reilly
Middle Tennessee State University: Aleka Blackwell
Minnesota State University Mankato: Rebecca Bates, Dean Kelley, Louise Chan
Montclair State University: Anna Feldman
Northeastern Illinois University: Ariana Bancu, Lewis Gebhardt
Northwestern University: Alaina Arthurs
Ohio State University: Michael White, Micha Elsner, Marie de Marneffe
Oregon Mathletics: Shirley Ma
Oregon State University: Liang Huang
Princeton University: Christiane Fellbaum, Eve Fleisig, Rishi Mago, Abinitha Gourabathina
NACLO 2020 Organizers (cont’d)

USA Contest Site Coordinators (cont’d):
San Diego State University: Rob Malouf
Southern Illinois University: Vicki Carstens, Jeffrey Punske
SpringLight Education Institute: Sherry Wang
Stanford University: Daisy Leigh, Eli Strauss-Reis, Matthew Early
Stony Brook University: Lori Repetti, Sarena Romano, Jeffrey Heinz
UCLA: Sue Han, Lily Kawaoto
Union College: Kristina Striegnitz, Nick Webb
University of California, Irvine: Sameer Singh, Zhengli Zhao, Kristen Salsbury
University of Colorado at Boulder: Silva Chang
University of Houston: Thamar Solorio, Deepti Bhat, Giovanni Molina
University of Illinois at Urbana-Champaign: Benjamin Leff, Greg Sigalov, Julia Hockenmaier
University of Kentucky: Kevin McGowan, Andrew Byrd
University of Maryland: Kasia Hitzckenko, Laurel Perkins, Aaron Doliana, Sigwan Thivierge, Nadiya Klymenko
University of Massachusetts, Lowell: Anna Rumshisky, David Donahue, Willie Boag
University of Massachusetts: Andrew Lamont, Anastasia Chobany
University of Memphis: Vasile Rus
University of Michigan: Steven Abney, Sally Thomason, Marcus Berger
University of Nebraska, Omaha: Parvathi Chundi
University of North Carolina Charlotte: Wlodek Zadrozny, Hossein Hematialam, Kodzo Wegba
University of North Texas: Rodney Nielsen
University of Notre Dame: David Chiang
University of Pennsylvania: Chris Callison-Burch, Mitch Marcus, Cheryl Hickey, Oliver Sayeed, Marianna Apidi-anaki, Derry Wijaya, Anne Cocos
University of Southern California, ISI campus: Jon May, Nima Pourdamghani
University of Texas at Dallas: Vincent Ng, Jing Lu, Gerardo Ocampo Diaz
University of Utah: Brendan Terry, Jessica Larsen, Justin Nistler, Joselyn Rodriguez
University of Washington: Jim Hoard, Joyce Parvi
University of Wisconsin, Milwaukee: Joyce Boyland, Hanyon Park, Gabriella Pinter, Anne Pycha
Western Washington University: Kristin Denham
Yale University: Raffaella Zanuttini
NACLO 2020 Organizers (cont’d)

Canada Contest Site Coordinators:
Dalhousie University: Vlado Keselj, Dijana Kosmajac
Simon Fraser University: Ashley Farris-Trimble
University of British Columbia: Yadong Liu, Jozina Vander Klok
University of Ottawa: Andrés Pablo Salanova
University of Toronto: Minh-Tam Nguyen, Lola Bradford
University of Western Ontario: Janis Chang
University of Calgary: Dennis Storoshenko
University of Alberta: Herbert Colston, Sally Rice
McGill University: Lisa Travis
NACLO 2020 Organizers (cont’d)

Booklet Editors:
Dragomir Radev, Yale University
Ethan Chi, Stanford University
Ji Hun Wang, Stanford University

Sponsorship Chair:
James Pustejovsky, Brandeis University

Sustaining Donors:
Linguistic Society of America
North American Chapter of the Association for Computational Linguistics
National Science Foundation

University Donors:
Brandeis University
Carnegie Mellon University
Massachusetts Institute of Technology
Middle Tennessee State University
Yale University

Many generous individual donors

Special thanks to:
The hosts of the 200+ High School Sites

All material in this booklet © 2020, North American Computational Linguistics Open Competition and the authors of the individual problems. Please do not copy or distribute without permission.
(A) Let That Mongo! (1/2) [5 Points]

Mongo (also known as Nkundo or Lomongo) is a Bantu language spoken by the Mongo Peoples of the central Democratic Republic of the Congo. Presently, there are around 400,000 native speakers spread out over a large area around the Congo River.

Below is a table showing a few verb conjugations in Lomongo. [dʒ] is a consonant pronounced like the [j] in the English word jump. [ŋ] is a consonant pronounced like the [ng] at the end of the English word sing.

<table>
<thead>
<tr>
<th>Imperative</th>
<th>2nd singular</th>
<th>3rd singular</th>
<th>3rd plural</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>bota</td>
<td>oota</td>
<td>aota</td>
<td>baota</td>
<td>‘beget’ (to give rise to; to bring about)</td>
</tr>
<tr>
<td>kamba</td>
<td>okamba</td>
<td>akamba</td>
<td>bakamba</td>
<td>‘work’</td>
</tr>
<tr>
<td>imedʒa</td>
<td>wimedʒa</td>
<td>imedʒa</td>
<td>bimedʒa</td>
<td>‘consent’</td>
</tr>
<tr>
<td>usa</td>
<td>wusa</td>
<td>usa</td>
<td>busa</td>
<td>‘throw’</td>
</tr>
<tr>
<td>bata</td>
<td>oata</td>
<td>aata</td>
<td>baata</td>
<td>‘get’</td>
</tr>
<tr>
<td>ɛna</td>
<td>wɛna</td>
<td>ɛna</td>
<td>bɛna</td>
<td>‘see’</td>
</tr>
<tr>
<td>isa</td>
<td>wisa</td>
<td>isa</td>
<td>bisa</td>
<td>‘hide’</td>
</tr>
<tr>
<td>dʒila</td>
<td>odʒila</td>
<td>adʒila</td>
<td>badʒila</td>
<td>‘wait’</td>
</tr>
<tr>
<td>ina</td>
<td>wina</td>
<td>ina</td>
<td>bina</td>
<td>‘hate’</td>
</tr>
<tr>
<td>bina</td>
<td>oina</td>
<td>aina</td>
<td>baina</td>
<td>‘dance’</td>
</tr>
<tr>
<td>asa</td>
<td>wasa</td>
<td>asa</td>
<td>basa</td>
<td>‘search’</td>
</tr>
<tr>
<td>saŋga</td>
<td>osaŋga</td>
<td>asaŋga</td>
<td>basaŋga</td>
<td>‘say’</td>
</tr>
</tbody>
</table>
A1. Explain how these Mongo verb forms work by filling in the blanks below in the Answer Sheets.

Each Mongo verb has a root form. The 4 verb forms shown here are formed by adding a prefix before the root form. The prefix for the imperative form is ___(1)___, the prefix for the 2nd singular form is ___(2)___, the prefix for the 3rd singular form is ___(3)___, and the prefix for the 3rd plural form is ___(4)___. (Note that some of these prefixes may be empty; to note this, write the symbol Ø-).

However, we are not done yet: to get the final verb form, we must apply some sound change rules. The relevant rules are:
1. If there are two ___(5)___, in a row, delete ___(6)___.
2. Delete ___(7)___ when it appears between two ___(8)___.
3. Change ___(9)___ to ___(10)___ when it appears before a ___(11)___.

There is one final wrinkle: the order that these rules are applied in matters. The rules must be applied in this order: First apply rule ___(12)___, then rule ___(13)___, then rule ___(14)___.

A2. Fill in the blanks (1-19) in the table below. Record your answers in the Answer Sheets.

<table>
<thead>
<tr>
<th>Imperative</th>
<th>2nd singular</th>
<th>3rd singular</th>
<th>3rd plural</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>bakisa</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>‘add’</td>
</tr>
<tr>
<td>(4)</td>
<td>wanda</td>
<td>(5)</td>
<td>(6)</td>
<td>‘begin’</td>
</tr>
<tr>
<td>solola</td>
<td>(7)</td>
<td>(8)</td>
<td>basolola</td>
<td>‘chat’</td>
</tr>
<tr>
<td>ponama</td>
<td>(9)</td>
<td>aponama</td>
<td>(10)</td>
<td>‘elect’</td>
</tr>
<tr>
<td>(11)</td>
<td>oowaa</td>
<td>(12)</td>
<td>(13)</td>
<td>‘cure’</td>
</tr>
<tr>
<td>(14)</td>
<td>(15)</td>
<td>aalusa</td>
<td>(16)</td>
<td>‘turn’</td>
</tr>
<tr>
<td>loŋga</td>
<td>(17)</td>
<td>(18)</td>
<td>(19)</td>
<td>‘win’</td>
</tr>
</tbody>
</table>
(B) A Cat in a Hat (1/2) [15 Points]

Chintang (Chintāṅ / Chhintang) is an eastern Kiranti language spoken by 5,000 to 6,000 people in Chhintang and Ahale municipalities of Dhankuta District, Koshi Zone, Nepal. Its dialects are Mulgaun and Sambhugaon. A few of the characters used to represent the words in this language may be unfamiliar. ʔ is a glottal stop, the sound heard in the middle of “uh-oh.” ɳ is the sound made by the ng in sing. ʌ is the sound made by the o in won.

Below are 16 sentences in Chintang written in the International Phonetic Alphabet, and their unordered English translations:

1. cuwa uthurumbeʔ yuŋno a. There is a hole in the towel.
2. appa chintaŋbeʔ yuŋno b. The woman has gone away.
3. sencak sie c. The rice has been cooked.
4. wapaŋa topi wadaŋse d. There is a hat on the head.
5. kok thuktaŋse e. My mother-in-law slept.
6. ram harinɨŋ khoŋno f. You go to the market.
7. kʌp kedadaŋse g. The water is in his mouth.
8. taŋbeʔ topi yuŋno h. Joge sent a letter.
9. menwaŋa sencak sede i. The mouse died.
10. tawelbeʔ uhoŋ yuŋno j. The woman has bought a chicken.
11. anambaŋa cuwa thuŋno k. The cup has been broken.
12. mechacha khadaŋse l. My father is in Chintang.
13. jogeŋa citthi hakte m. The rooster has put on a hat.
14. anamma imse n. A cat killed a mouse.
15. hana bajar akhaʔno o. Ram plays with Hari.

B1. Match the Chintang sentences (1-16) with their corresponding English translation (a-p). Record your answers in the Answer Sheets.

n → a → c → l → o
(B) A Cat in a Hat (2/2)

B2. Translate the following into Chintang. Note that some English words may be translated as part of a Chintang word. Record your answers in the Answer Sheets.

   a. There is a cat in a hat.
   b. Joge plays with a chicken.
   c. My hen is in the market.
   d. parent-in-law

B3. Translate the following into English. Your answers should be structurally similar to the English translations given in the data. Record your answers in the Answer Sheets.

   a. athurumbe? kok yuŋno
   b. appa khade
   c. anamma ammaninj yuŋno
Old Persian, one of the two attested Old Iranian languages, was spoken from 600-300 BCE in Achaemenid Persia. Old Persian was written in cuneiform, a writing system produced using wedge-shaped marks in clay tablets inherited from the Sumerian Empire.

Below are some words written in Old Persian Cuneiform. On the next page are their transcriptions and English translations in no particular order. Note that one word can be written in two different ways in cuneiform!

<table>
<thead>
<tr>
<th>Number</th>
<th>Cuneiform</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>אל א</td>
</tr>
<tr>
<td>2</td>
<td>אכ אל כ</td>
</tr>
<tr>
<td>3</td>
<td>אכ אל כ</td>
</tr>
<tr>
<td>4</td>
<td>אכ ול</td>
</tr>
<tr>
<td>5</td>
<td>אכ כ</td>
</tr>
<tr>
<td>6</td>
<td>אכ כ</td>
</tr>
<tr>
<td>7</td>
<td>אכ כ</td>
</tr>
<tr>
<td>8</td>
<td>אכ כ</td>
</tr>
<tr>
<td>9</td>
<td>אכ כ</td>
</tr>
<tr>
<td>10</td>
<td>אכ כ</td>
</tr>
<tr>
<td>11</td>
<td>אכ כ</td>
</tr>
<tr>
<td>12</td>
<td>אכ כ</td>
</tr>
<tr>
<td>13</td>
<td>אכ כ</td>
</tr>
<tr>
<td>14</td>
<td>אמכ (\cdot) כ (\cdot) ל</td>
</tr>
<tr>
<td>15</td>
<td>אמכ</td>
</tr>
<tr>
<td>16</td>
<td>אמכ (\cdot) ל</td>
</tr>
<tr>
<td>17</td>
<td>אמכ</td>
</tr>
<tr>
<td>18</td>
<td>אמכ</td>
</tr>
<tr>
<td>19</td>
<td>אמכ</td>
</tr>
<tr>
<td>20</td>
<td>אמכ</td>
</tr>
<tr>
<td>21</td>
<td>אמכ</td>
</tr>
<tr>
<td>22</td>
<td>אמכ</td>
</tr>
<tr>
<td>23</td>
<td>אמכ</td>
</tr>
<tr>
<td>24</td>
<td>אמכ</td>
</tr>
<tr>
<td>25</td>
<td>אמכ</td>
</tr>
<tr>
<td>26</td>
<td>אמכ</td>
</tr>
</tbody>
</table>
Here are the transcriptions and English translations of the words on the previous page in no particular order. Note that y, š and č are consonants; ā, ī, and ū are long versions of their corresponding vowels (a, i, and u). Capitalization in transcription is not reflected in the Persian script.

| A.  | paruvam | previously       | N.  | Kuruš   | Cyrus           |
| B.  | hadugā  | record, statue   | O.  | asmā    | sky             |
| C.  | āyadana | sanctuary       | P.  | Bagadāta | (a male name)¹ |
| D.  | dāruv   | wood            | Q.  | Hiduš   | India           |
| E.  | duruxta | lie             | R.  | hača    | from            |
| F.  | Čišpaiš | Tespes (a king of Persia) | S.  | bājim   | tribute, toll   |
| G.  | saiymam | silver          | T.  | Arabāya | Arabia          |
| H.  | bar     | to bear         | U.  | Harāiva | (a female name) |
| I.  | Skudra  | Thrace          | V.  | daiva   | false god       |
| J.  | baga    | god             | W.  | Ūvja    | Elam (a place name) |
| K.  | pasāva  | after           | X.  | hakaramčīy | once     |
| L.  | Ākaufačiyā | a tribe of southeastern Iran | Y.  | Dārayauš | Darius (a king of Persia) |
| M.  | radiy   | because of      |     |         |                 |

C1. Determine the correct correspondences. Record your answers in the Answer Sheets.

¹ Equivalent to the Greek name Theodoros ("God-given")
(D) Pay Attention (1/2) [10 Points]

The meaning of a word depends on its context. For example, in the sentence “The farmer seeded the field with corn,” the word seeded means “added seeds to.” However, in the sentence “The chef seeded the tomato,” the word seeded means “took seeds away from.”

If you were building a model of language, how would you get it to recognize the way that a word’s meaning depends on context? One popular technique for achieving this goal is a mechanism called attention. In the way that attention is implemented in current state-of-the-art models of language, the model has a large number of attention heads, each of which is denoted by a pair of numbers (for examples, 8-10). When the model processes a sentence, for every pair of words in the sentence, each head calculates the “relatedness” of the two words.

The one wrinkle is that we do not know what exactly “relatedness” should mean, so instead of telling the model how to define “relatedness,” we let the model learn its own definition of relatedness. Recently, computer scientists have started to analyze what these attention heads have learned, and this analysis shows that they often reflect linguistic information! For example, here’s the output of one attention head (head 8-10) when we feed the following sentence into BERT, which is one of the most popular models that uses attention heads:

Example: I see my sister, but she can’t see me because she is reading a linguistics book.

Output: 4 → 2, 9 → 8, 16 → 13

This output signifies that head 8-10 connects word #4 (sister) to word #2 (see), as well as word #9 (me) to word #8 (see) and word #16 (book) to word #13 (reading). If you consider what all of those pairs of words have in common, you’ll see that each one is a verb and its direct object: sister is the direct object of the first instance of see, me is the direct object of the second instance of see, and book is the direct object of reading. It appears that head 8-10 has learn to connect verbs to their objects! (Note that these activations are directional; for example, word #2 is not connected to word #4.)

Why is this information useful? If we go back to the example with the verb seed, this sort of information can help the model figure out which version of seed is being used: If its direct object is something like field or lawn, then it probably means “to add seeds to;” if its direct object is something like tomato or watermelon, then it probably means “to take seeds away from.” Of course, one sentence isn’t enough to draw strong conclusions. Instead, computer scientists tend to use a corpus, or a database, of example sentences to find patterns in the data. On the next page is a small corpus, the NacloWeb Corpus\(^1\), which has 7 sentences.

\(^1\) Some sentences derived from data in the English Web Treebank.
(D) Pay Attention (2/2)

NacloWeb Corpus

1. My experience with Gelda’s House of Gelbelgarg has been extremely wonderful.
2. We use Google’s models to delve into the inner workings of language.
3. At this corporation’s meeting, people are concerned about the company’s plans.
4. In July, we will interview the candidate and review her resume again.
5. The platypus is a strange animal, with its eggs and its webbed feet.
6. I think that although my NACLO exam was difficult, it was a lot of fun.
7. Linguistics is a beautiful science that provides interdisciplinary insight into the human experience.

Note that the NacloWeb corpus treats the possessive clitic ‘s as a separate word. (So in Sentence #1, word #5 is ‘s and word #6 is House.)

In our experiment on the NacloWeb Corpus, we ran each of the corpus’ sentences through BERT and recorded the outputs of four attention heads (8-11, 7-6, 9-6, and 5-4). Unfortunately, due to some extremely sloppy experimental procedure, we don’t remember which order we ran them through the model; in addition, we forgot to record some data. Your job is to fill in the blanks! Note that some blanks may have more than one connection, and some may have none at all.

<table>
<thead>
<tr>
<th>Sentence</th>
<th>8-11</th>
<th>7-6</th>
<th>9-6</th>
<th>5-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sentence A</td>
<td>12 → 13</td>
<td>5 → 6</td>
<td>14 → 13</td>
<td>10 → 6</td>
</tr>
<tr>
<td>Sentence B</td>
<td>(a)</td>
<td>8 → 9, 11 → 12</td>
<td>None</td>
<td>8 → 2, 11 → 2</td>
</tr>
<tr>
<td>Sentence C</td>
<td>2 → 3, 10 → 11</td>
<td>4 → 5, 12 → 13</td>
<td>(b)</td>
<td>11 → 3</td>
</tr>
<tr>
<td>Sentence D</td>
<td>(c)</td>
<td>4 → 5</td>
<td>12 → 13</td>
<td>None</td>
</tr>
<tr>
<td>Sentence E</td>
<td>3 → 4, 11 → 12</td>
<td>(d)</td>
<td>10 → 12</td>
<td>5 → 1</td>
</tr>
<tr>
<td>Sentence F</td>
<td>(e)</td>
<td>1 → 2, 5 → 6</td>
<td>7 → 8</td>
<td>None</td>
</tr>
<tr>
<td>Sentence G</td>
<td>(f)</td>
<td>(g)</td>
<td>(h)</td>
<td>(i)</td>
</tr>
</tbody>
</table>

D1. Identify sentences A-G. Record your answers in the Answer Sheets.

D2. Fill in the missing data, labelled (a) to (i), in the table above. Record your answers in the Answer Sheets.
Breton is a language spoken by approximately 200,000 people in Brittany, France. Part of the Celtic family of the Indo-European languages, it is distantly related to English, as well as other European languages such as French and Russian.

Below are some equations in Breton:

\[
\begin{align*}
\text{trizek} + \text{daouzek} &= \text{pemp warn ugent} \\
\text{unan ha pevar-ugent} \div \text{nav} &= \text{nav} \\
\text{pevar ha tri-ugent} - \text{ugent} &= \text{pevar ha daou-ugent} \\
\text{seizh warn ugent} + \text{pevarzek} &= \text{unan ha daou-ugent} \\
\text{daou} \times \text{seizh} &= \text{pevarzek} \\
\text{kant} \div \text{daou} &= \text{hanter kant} \\
\text{nav} \times c'\text{hwec'h} &= \text{pevar ha hanter kant} \\
\text{c'hwec'h ha tri-ugent} \div \text{tri} &= \text{daou warn ugent} \\
\text{c'hwezek} \times c'\text{hwec'h} &= \text{c'hwezek ha pevar-ugent} \\
\text{daouzek} \times \text{pemp} &= \text{tri-ugent}
\end{align*}
\]

**E1.** In the Answer Sheets, fill in the gaps in the following equations.

a. \( \text{pevar-ugent} \div \text{pemp} = \) _______________

b. \( \text{pemp ha hanter kant} - \text{daouzek} = \) _______________

c. \( \text{nav warn ugent} + \) _______________ = \( \text{tri ha daou-ugent} \)

d. \( \text{kant} \div \) _______________ = \( \text{pemp} \)

**E2.** As well as an interesting numbering system, Breton has an unusual method of forming the plurals of some nouns, which is partly connected to the numbering system. Here are three plural nouns in Breton: which of them means “(one person’s) eyes”? Record your answer in the Answer Sheets.

(a) \( \text{elerc’h} \)  
(b) \( \text{daoulagad} \)  
(c) \( \text{perennoù} \)

**E3.** An “irregular” number in the Breton system is \( \text{triwec’h} \). It represents a number between 10 and 20. Which one? Record your answer in the Answer Sheets.
(F) Coming into Focus (1/2) [15 Points]

Paiwan is an Austronesian language spoken by around 66,000 people in southern Taiwan. One of the major components of Paiwan sentence structure is “focus,” which marks a new piece of information conveyed by the sentence. In English, we might represent this through phrasing, such as in sentence “It is the dog which the man likes”. In this example, the dog is focused.

Below are some sentences in Paiwan with their English translations. Sentence elements in italics are focused.

<table>
<thead>
<tr>
<th>Paiwan</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. kanan nua uqaɬay tua kuka a quma nua tsakaw</td>
<td>The man eats the chicken in the thief’s field.</td>
</tr>
<tr>
<td>2. tjmalaw tua vavuy a kuvatu</td>
<td>My dog angers the pig.</td>
</tr>
<tr>
<td>3. djavisen nua tsemas a kukama</td>
<td>The spirit snatches my father.</td>
</tr>
<tr>
<td>4. sitarang nua uqaɬay a vuluq</td>
<td>The man protects (it) with the spear.</td>
</tr>
<tr>
<td>5. tjalawen nua suvavuy i tua umaq a aɬak nua vavaian</td>
<td>Your pig angers the woman’s child in the house.</td>
</tr>
<tr>
<td>6. kman tua kuka a tsemas</td>
<td>The spirit eats the chicken.</td>
</tr>
<tr>
<td>7. djavisan nua pulingaw tua vuluq a gadu</td>
<td>The shaman snatches the spear in the mountain.</td>
</tr>
<tr>
<td>8. langedaen nua sivitay a qaya-qayam</td>
<td>The soldier hears the bird.</td>
</tr>
</tbody>
</table>

F1. How would you say these sentences in Paiwan? Record your answers in the Answer Sheets.

a. The man protects the field with the dog.

b. Your shaman angers my bird in the spirit’s mountain.

c. The woman snatches the pig.
Now look at the following question-answer dialogues. The first answer has been translated for you.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. inu a tmarang a tsakaw?</td>
<td>tmarang a tsakaw i tua quma</td>
</tr>
<tr>
<td></td>
<td>The thief who protects (it) is in the field.</td>
</tr>
<tr>
<td>10. anema a sitjalaw nua sukama tua vatu?</td>
<td>sitjalaw nua kukama tua vatu a kuvuluq</td>
</tr>
<tr>
<td>11. anema a sudjavisen?</td>
<td>kudjavisen a qaya-qayam nua vavaian</td>
</tr>
<tr>
<td>12. inu a kanan nua uqaɬay?</td>
<td>kanan nua uqaɬay a gadu</td>
</tr>
</tbody>
</table>

F2. Based on these examples, translate the following responses into English, underlining focused elements, and saying what questions (in Paiwan) could have prompted them. Record your answers in the Answer Sheets.

a. susitarang tua qaya-qayam nua pulingaw a tsemas
b. kanen nua uqaɬay a vavuy i tua gadu
c. kutjalawan tua suvatu a kuquma

(The letter pairs dj and tj each represent a single sound. The word langedaen in sentence 8 is actually langedain, but this was edited for the sake of simplicity.)
**G) Password Confusion (1/3) [10 Points]**

Mary, Larry, and Harry are three friends sharing an apartment. Unfortunately, their nosy neighbor Perry is always trying to use their wifi, so Mary changes their wifi password frequently to thwart Perry’s efforts. Whenever she changes the password, Mary texts the new password to Larry and Harry.

One day, Mary opens their wifi bill and can tell from the exorbitant charge that Perry has been using it again. Since this can only mean that Perry is somehow reading their texts, Mary hires a company called the Rearranging Expressions Organization (or REOrganization for short) to give her advice on making her messages more secure. REOrganization advises her to send messages that can be decoded by the following 2-step process:

1. Convert the sentence to a question;
2. Read the first letter of each word in the question to yield the password.

As it turns out, Larry and Harry are not very inquisitive people, so they have never encountered questions before. Therefore, Mary gives them the following example messages to show how the system works:

<table>
<thead>
<tr>
<th>Text message</th>
<th>Text message converted to a question</th>
<th>Decoded password</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deciphering each Alaskan license plate abbreviation is lovely.</td>
<td>Is deciphering each Alaskan license plate abbreviation lovely?</td>
<td>IDEAL PAL</td>
</tr>
<tr>
<td>A new German exchange rate beneath a newspaper did assist national ambassadors.</td>
<td>Did a new German exchange rate beneath a newspaper assist national ambassadors?</td>
<td>DANGER BANANA</td>
</tr>
<tr>
<td>Every industrial geographer hired through your legal action was yelling enthusiastic random stuff.</td>
<td>Was every industrial geographer hired through your legal action yelling enthusiastic random stuff?</td>
<td>WEIGHTY LAYERS</td>
</tr>
</tbody>
</table>

Why have this extra step of forming a question? The idea is that the initial letters from the original text messages can also spell two-word chunks (DEAL PAIL, ANGER BANDANA, and EIGHTY LAWYERS), so perhaps Perry will be thrown off the scent by these distractor phrases.
(G) Password Confusion (2/3)

**G1.** Larry and Harry both seemed to understand the examples Mary showed them, so she began using this system to encode the new passwords. It went swimmingly for the first few weeks, but then Larry and Harry occasionally began to get the password wrong. Below are all of the messages Mary sent out, along with the passwords that her roommates extracted from the messages. A few cells of the table have been left blank; in the Answer Sheets, fill them in.

<table>
<thead>
<tr>
<th>Text message</th>
<th>Distractor password</th>
<th>Larry’s password guess</th>
<th>Harry’s password guess</th>
<th>Correct password</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uplifting tales told extremely rapidly in New Guinea and Romania may reveal each storyteller’s trade secrets.</td>
<td>UTTERING ARMRESTS</td>
<td>MUTTERING ARRESTS</td>
<td>MUTTERING ARRESTS</td>
<td>MUTTERING ARRESTS</td>
</tr>
<tr>
<td>Lively orangutans using discarded branches as tambourines can harmonize.</td>
<td>LOUD BATCH</td>
<td>CLOUD BATH</td>
<td>CLOUD BATH</td>
<td>CLOUD BATH</td>
</tr>
<tr>
<td>Horned owls should endure every modern orange tree iguanas can offer next summer.</td>
<td>HOSE EMOTICONS</td>
<td>CHOSE EMOTIONS</td>
<td>SHOE EMOTICONS</td>
<td>SHOE EMOTICONS</td>
</tr>
<tr>
<td>Every loud electronic creature that interesting odd numbers should provide at reunions should escape.</td>
<td>ELECTION SPARSE</td>
<td>SELECTION SPARE</td>
<td>SELECTION PARSE</td>
<td>SELECTION SPARE</td>
</tr>
<tr>
<td>Alligators that can launch airplanes may prosper.</td>
<td>AT CLAMP</td>
<td>MAT CLAP</td>
<td>CAT LAMP</td>
<td>MAT CLAP</td>
</tr>
<tr>
<td>Unions should identify novel geometric systems that one may possibly seek.</td>
<td>USING STOMPS</td>
<td>MUSING STOPS</td>
<td>SUING STOMPS</td>
<td>SUING STOMPS</td>
</tr>
<tr>
<td>Happy animals that will investigate telescopes can hop.</td>
<td>HAT WITCH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All North Dakotan deviled eggs should seem especially radiant today.</td>
<td>AND DESSERT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aardvarks may publicly label each spanning tree algorithm talented unicorns should enthusiastically see.</td>
<td>AMPLE STATUSES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anyone rabbits might surprise has elicited a response that has satisfied.</td>
<td>ARMS HEARTHS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Mary does not want all this confusion about the password scheme, so she switches to a different encoding scheme: She will still send out a message, but her roommates will now need to negate the message so that it means the opposite of its original meaning, rather than turning it into a question as previously. Shockingly, Larry and Harry are such positive people that they have never encountered negation before, so Mary sends them the following examples of how the encoding scheme works:

<table>
<thead>
<tr>
<th>Text message</th>
<th>Negated text message</th>
<th>Decoded password</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charming refrigerator operators will waltz into Greenland.</td>
<td>Charming refrigerator operators will not waltz into Greenland.</td>
<td>CROWN WIG</td>
</tr>
<tr>
<td>Quiet utilitarians in crowded Kenyan city halls are talking.</td>
<td>Quiet utilitarians in crowded Kenyan city halls are not talking.</td>
<td>QUICK CHANT</td>
</tr>
</tbody>
</table>

**G2.** Larry and Harry understood these examples just fine, but once again Mary found them making some errors in future weeks when she sent out the actual encoded passwords! The following table contains some of the messages Mary sent out; in the Answer Sheets, fill in the blank spaces.

<table>
<thead>
<tr>
<th>Text message</th>
<th>Distractor password</th>
<th>Larry’s password guess</th>
<th>Harry’s password guess</th>
<th>Correct password</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark’s emptiest factory is exporting some pasta Russia is cooking each Saturday.</td>
<td>DEFIES PRICES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unions Nepal is forbidding over recent major events during breakfast are keeping exceptional records.</td>
<td>UNIFORMED BAKER</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

At this point, Mary decides to simply tell Larry and Harry the passwords in person.

**Note:** The problem that these three friends face is that the examples Mary sent out were consistent with multiple possible rules. In linguistics, this type of problem is called the poverty of the stimulus, and it is a central topic in language acquisition: How is it that all children with English-speaking parents learn essentially the same version of English, even though the sentences that they hear are consistent with many possible rules for defining the structure of the language?
In 1850, a farmer from a village in Cyprus discovered a tablet dating from the 5th century BCE, which recorded an endowment from the city of Idalion to a family of physicians. Now known as the Idalion Tablet, this document was of enormous importance for the decipherment of the Cypriot script in which it was written. The tablet is in the Cypriot dialect of ancient Greek.

Here is a portion of the inscription, with a transliteration below:

ote ta ptolin edalion kateworgon madoi kas ketiēwes i tōi philokuprōn wetei tō onasagorau basileus stasikupros kas ha ptolis edaliēwes anōgon onasilon tononasikuprōn toniyatēran kas tos kasignētos iyasthai tos athrōpos tos i tai makhai ikhimamenos aneu misthōn

H1. Here are four other words from the Idalion Tablet. Write them in the Cypriot script. Record your answers in the Answer Sheets.

helei athanas kathethiyan dowenai

H2. Here is the English translation of this section of the text:

“When the Medes and the Kitions subdued the city of Idalion in the year of Philokypros son of Onasagoras, King Stasikypros and the city of the Idalians instructed Onasion the son of Onasikypros the physician, and his brothers, to heal the men wounded in the battle, without a fee.”

What are the Cypriot Greek for (a) and, (b) king, (c) instructed? Write them in the Cypriot script. Record your answers in the Answer Sheets.
Name: ___________________________________________
Contest Site: ________________________________________
Site ID:  ____________________________________________
City, State: _________________________________________
Grade: ______

Please also make sure to write your registration number and your name on each page that you turn in.

SIGN YOUR NAME BELOW TO CONFIRM THAT YOU WILL NOT DISCUSS THESE PROBLEMS WITH ANYONE
UNTIL THEY HAVE BEEN OFFICIALLY POSTED ON THE NACLO WEBSITE IN APRIL.

Signature:  ____________________________________________
Demographics

Gender: [ ] Female [ ] Male [ ] Other: ____________________________ [ ] Prefer not to respond

If you are competing for the US, please fill out this box:
Do you consider yourself Hispanic/Latinx?
[ ] Yes
[ ] No
[ ] Prefer not to respond
Which of the following categories describe you? Select all that apply.
[ ] American Indian or Alaskan Native
[ ] Asian
[ ] Black or African American
[ ] Native Hawaiian or Pacific Islander
[ ] White
[ ] Other: ______
[ ] Prefer not to respond

If you are competing for Canada, please fill out this box:
Which of the following categories describe you? Select all that apply.
[ ] Non-Indigenous
[ ] Métis
[ ] First Nations
[ ] Inuit
[ ] Other: ______
[ ] Prefer not to respond
Which of the following categories describe you? Select all that apply
[ ] Arab
[ ] Black
[ ] Chinese
[ ] Filipino
[ ] Japanese
[ ] Korean
[ ] Latin American
[ ] South Asian
[ ] Southeast Asian
[ ] West Asian (e.g. Iranian, Afghan, etc.)
[ ] White
[ ] Other: ______
[ ] Prefer not to respond
### Answer Sheets (1/7)

#### (A) Let That Mongo!

1. 

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 2. 

<table>
<thead>
<tr>
<th>Imperative</th>
<th>2nd singular</th>
<th>3rd singular</th>
<th>3rd plural</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>bakisa</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>‘add’</td>
</tr>
<tr>
<td></td>
<td>(4)</td>
<td>wanda</td>
<td>(5)</td>
<td>(6)</td>
</tr>
<tr>
<td>solola</td>
<td>(7)</td>
<td>(8)</td>
<td>basolola</td>
<td>‘chat’</td>
</tr>
<tr>
<td>ponama</td>
<td>(9)</td>
<td>aponama</td>
<td>(10)</td>
<td>‘elect’</td>
</tr>
<tr>
<td></td>
<td>(11)</td>
<td>oowa</td>
<td>(12)</td>
<td>(13)</td>
</tr>
<tr>
<td></td>
<td>(14)</td>
<td>(15)</td>
<td>aalusa</td>
<td>(16)</td>
</tr>
<tr>
<td>longa</td>
<td>(17)</td>
<td>(18)</td>
<td>(19)</td>
<td>‘win’</td>
</tr>
</tbody>
</table>
(B) A Cat in a Hat

1. [ ] 2. [ ] 3. [ ] 4. [ ]
   5. [ ] 6. [ ] 7. [ ] 8. [ ]
   9. [ ] 10. [ ] 11. [ ] 12. [ ]
   13. [ ] 14. [ ] 15. [ ] 16. [ ]

2. a. 
   b. 
   c. 
   d. 

3. a. 
   b. 
   c. 

n a c l o
(C) Set in Stone

1.  1.  2.  3.  4.  5.  6.  7.  
    15.  16.  17.  18.  19.  20.  21.  

(D) Pay Attention

1. Write one number from 1 to 7 per box:

   A  B  C  D  
   E  F  G  

2. Fill in the blanks:

<table>
<thead>
<tr>
<th>Sentence</th>
<th>8-11</th>
<th>7-6</th>
<th>9-6</th>
<th>5-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sentence A</td>
<td>12 → 13</td>
<td>5 → 6</td>
<td>14 → 13</td>
<td>10 → 6</td>
</tr>
<tr>
<td>Sentence B</td>
<td>(a)</td>
<td>8 → 9, 11 → 12</td>
<td>None</td>
<td>8 → 2, 11 → 2</td>
</tr>
<tr>
<td>Sentence C</td>
<td>2 → 3, 10 → 11</td>
<td>4 → 5, 12 → 13</td>
<td>(b)</td>
<td>11 → 3</td>
</tr>
<tr>
<td>Sentence D</td>
<td>(c)</td>
<td>4 → 5</td>
<td>12 → 13</td>
<td>None</td>
</tr>
<tr>
<td>Sentence E</td>
<td>3 → 4, 11 → 12</td>
<td>(d)</td>
<td>10 → 12</td>
<td>5 → 1</td>
</tr>
<tr>
<td>Sentence F</td>
<td>(e)</td>
<td>1 → 2, 5 → 6</td>
<td>7 → 8</td>
<td>None</td>
</tr>
<tr>
<td>Sentence G</td>
<td>(f)</td>
<td>(g)</td>
<td>(h)</td>
<td>(i)</td>
</tr>
</tbody>
</table>
(E) Breton Numbers

1. a. 
   b. 
   c. 
   d. 

2. Circle the word:
   (a) elerc’h  (b) daoulagad  (c) perennoù

3. Write the number:

(F) Coming into Focus

1. Translate into Paiwan:
   a. The man protects the field with the dog.

   b. Your shaman angers my bird in the spirit’s mountain.

   c. The woman snatches the pig.
(F) Coming into Focus (continued)

2. a.  *susitarang tua qaya-qayam nua pulingaw a tsemas*

   English translation of response (underline focused elements):

   

   Paiwan question that prompted the response:

   

b.  *kanen nua uqaɬay a vavuy i tua gadu*

   English translation of response (underline focused elements):

   

   Paiwan question that prompted the response:

   

c.  *kutjalawan tua suvatu a kuquma*

   English translation of response (underline focused elements):

   

   Paiwan question that prompted the response:

   

## (G) Password Confusion

1. Fill in the blanks:

<table>
<thead>
<tr>
<th>Text message</th>
<th>Distractor password</th>
<th>Larry’s password guess</th>
<th>Harry’s password guess</th>
<th>Correct password</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy animals that will investigate telescopes can hop.</td>
<td>HAT WITCH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All North Dakotan deviled eggs should seem especially radiant today.</td>
<td>AND DESSERT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aardvarks may publicly label each spanning tree algorithm talented</td>
<td>AMPLE STATUSES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>unicorns should enthusiastically see.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anyone rabbits might surprise has elicited a response that has satisfied.</td>
<td>ARMS HEARTHYS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Fill in the blanks:

<table>
<thead>
<tr>
<th>Text message</th>
<th>Distractor password</th>
<th>Larry’s password guess</th>
<th>Harry’s password guess</th>
<th>Correct password</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark’s emptiest factory is exporting some pasta Russia is cooking each</td>
<td>DEFIES PRICES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saturday.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unions Nepal is forbidding over recent major events during breakfast are</td>
<td>UNIFORMED BAKER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>keeping exceptional records.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(H) The Idalion Tablet

1. Write in the Cypriot script:

   helei

   athanas

   katethiyan

   dowenai

2. Write in the Cypriot script:

   (a) and

   (b) king

   (c) instructed