U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND – ARMY RESEARCH LABORATORY

Shareable TTS Components

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The Team

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TEXT-TO-SPEECH (TTS)

- **A system that converts written text to audible speech**

- **TTS is an important enabling language component**
  - For Speech-to-Speech systems (ASR → MT → TTS)
  - For information delivery tools such as ‘talking books’
  - Ultimately, every language community needs a TTS capability

- **USG has relied on commercial TTS software**
  - Licensed commercial products are cumbersome
  - Recent growth in neural computing for TTS with open tools
  - New prospects for more and better shareable TTS components

- **Publicly available neural implementations of TTS, such as Ito’s implementation of Google’s Tacotron, make creating one’s own shareable components easier**

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MAKING A SHAREABLE TTS COMPONENT

- **Recent neural (deep learning) methods simplify data preparation**
  - Google's 2017 Tacotron project followed by Keith Ito's implementation
- **Keith Ito's "LJ English" model built with 24 hours of training data**
  - ARL has developed Android Arabic TTS capability using deep learning methods and only 10 hours of training data
- **Compute time and computer resource requirements are substantial**
  - Aging GPU equipment not up to the task, not compatible with current libraries
- **Shareable data and shareable software is an important aspect**
  - ARL is using single speaker data based on in-house translation materials and VOA-type newswire as prompts
- **Neural TTS computes a spectrogram, then renders that data as synthesized speech using a vocoder**

OUR WORK TO DATE

- **Zak Al Sagheer: created 10 hour Arabic dataset**
  - Trained (K. Ito) Arabic Tacotron model
  - Trained Arabic Tacotron2 model
  - Trained more Arabic models: current success using FastSpeech 2
  - Trained vocoders using Arabic data and neural methods.

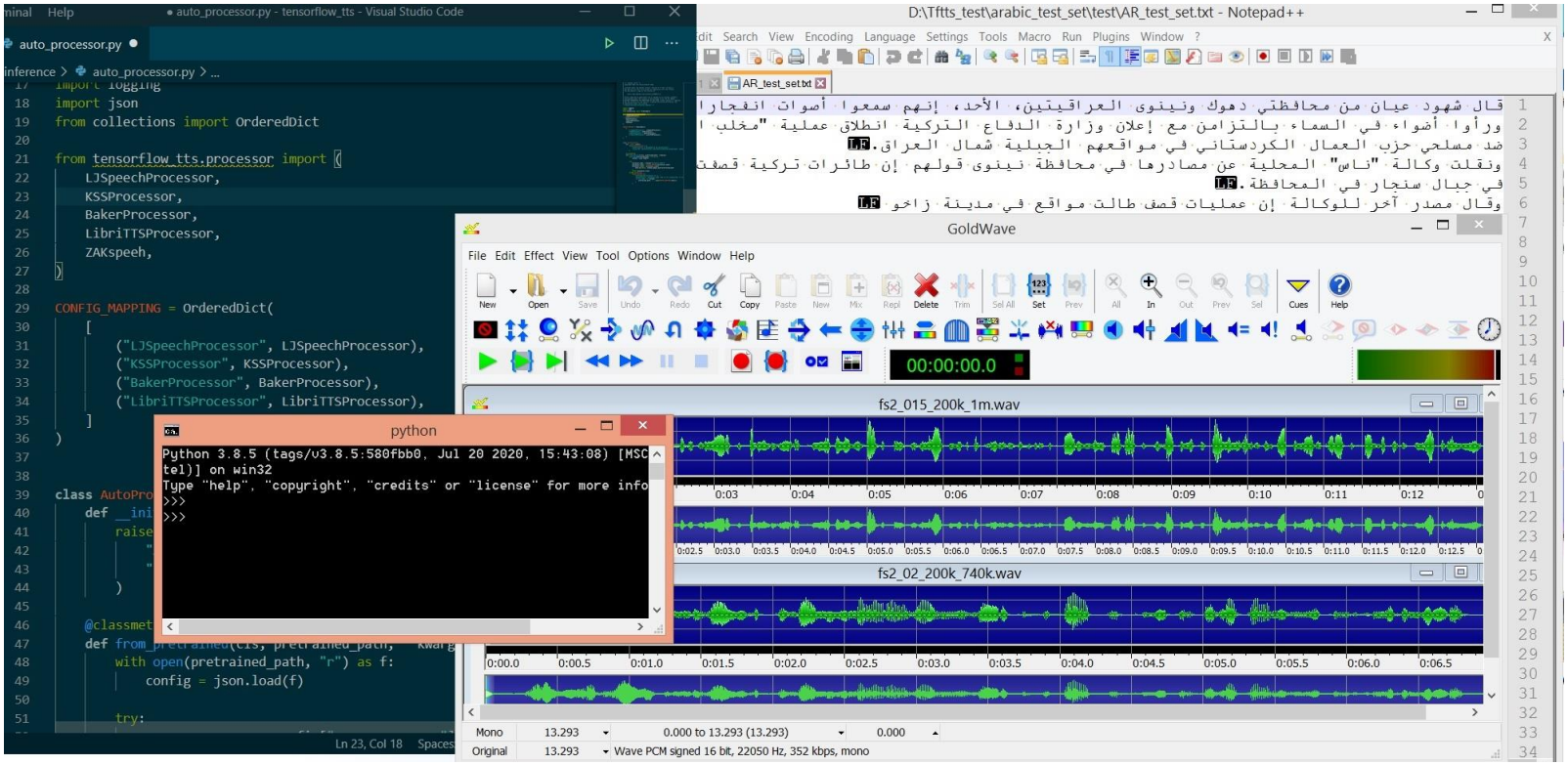
- **Hazrat Jahed: created 10 hour Pashto dataset**

- **UTTC (Vince Iglehart and Jerral Murray):**
  - Learned Python programming
  - Trained (K. Ito) Tacotron English model
  - Conducted experiments (formal vs. informal text; full vs. ablated dataset)
  - Surveyed possibilities for Northern Ute and/or Lakota dataset → TTS model

- **Gerry Cervantes provided Android expertise, TensorFlow, tflite**

LET'S SYNTHESIZE SOME ARABIC!

- **Demonstration by Zakariya (Zak) Al Sagheer**



A UTTC PERSPECTIVE: GOALS/CHALLENGES

- **Tacotron experiment this summer: small data results in a worse model**
- **Implications for building TTS models for under-resourced/under-documented languages**
- **Creating data resources for some of these languages: Northern Ute, Lakota**
- **Challenges for TTS models that are based on Native American language data**
- **TTS models offer new capabilities for communities**

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TTS FOR ACADEMICS

- **Teaching materials: introduction to STEM, computational linguistics for linguists and language enthusiasts alike**
- **Second language acquisition: empowering students to practice pronunciation outside the classroom**
- **Experimental materials: a component of the experimental paradigm and a better way to administer instructions to bilingual participants/those with weaker literacy**
- **Language documentation/revitalization: bridging the gap between reading and speaking**
- **Accessibility: free/easy access to screen-readers in many languages for a diverse student body**

GOALS

- **Extend the Ito implementation of Tacotron to build models for additional languages: Pashto, Native American languages, which can be shared. For free.**

- **Make these models transparent and well-documented so that they are easily modified to serve the needs of the military, the academy, and language communities**

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CONCLUSION

- **Speech technology including TTS serves military interests because it aids in the communication between Soldiers and local nationals who may not have a language in common or an interpreter available**

- **Speech technology including TTS serves Native American communities because it can help to preserve and revitalize Native American languages**

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