The PAL (Personalized Assistant that Learns) technologies originated from the DARPA PAL program, which focused on improving the way computers support humans through the use of cognitive systems—that is, systems that reason, learn from experience, and accept guidance in order to provide effective, personalized assistance.

SRI International has made available a collection of the successful machine learning and reasoning technologies developed on the PAL program for use by the broader DARPA, research, and military communities. These government off-the-shelf (GOTS) technologies include both focused learning applications and general-purpose learning methods. The PAL capabilities have been modularized, packaged, and adapted to industry standards to facilitate their incorporation into target applications. Various infrastructure components and application programming interfaces (APIs) are available to simplify integration into and interaction with the technologies.

The PAL technologies were developed by SRI International, Carnegie Mellon University, the University of Massachusetts, the University of Rochester, the Institute for Human and Machine Cognition, Oregon State University, the University of Southern California, and Stanford University.

### MILITARY TRANSITIONS

PAL technologies have been deployed within the U.S. Army’s Command Post of the Future (CPOF), and the U.S. Air Force Research Laboratory’s (AFRL) Web Enabled Temporal Analysis System (WebTAS). In addition, PAL technologies are being evaluated in United States Strategic Command’s (USSTRATCOM) Strategic Knowledge Integration Web (SKIWeb) and Integrated Strategic Planning and Analysis Network Global Adaptive Planning Collaborative Information Environment (ISSPAN GAP CIE), and the U.S. Navy Marine Corps Intranet (NMCI).

### PAL TECHNOLOGIES

#### Learning Applications

**Task Learning** employs learning by demonstration technology to enable a user to create a parameterized procedure for completing a class of tasks by simply performing an example of a task in that class. In this way, Task Learning can enable end-user automation of routine or time-consuming tasks. *(Deployed in CPOF; being evaluated in ISSPAN GAP CIE, WebTAS, and by the Navy)*

**Task Assistant** is a collaborative task management application that gives users the capability to author, edit, retrieve, share, and monitor task lists within a team. In this way, Task Assistant makes checklists or standard operating procedures into live, dynamic entities that can evolve and adapt over time. *(Deployed in CPOF; being evaluated in ISSPAN GAP CIE, WebTAS, and by the Navy)*

**iLink** is a social networking component that builds dynamic topic models for its users based on their activities within the network. iLink’s recommendation engine exploits those models to suggest experts or information artifacts relevant to a given topic. iLink also includes a FAQtory capability that can automatically build a FAQ repository based on observed Q&A activity within the network. *(Being evaluated in SKIWeb)*

**C2RSS** helps a user monitor information streams (e.g., RSS feeds) by identifying potentially relevant documents based on a learned model of the user’s interests. The system automatically classifies information by topic and relevance, leveraging user feedback to refine its suggestions. *(Being evaluated by the Navy)*

**CALO Express** is a lightweight personal desktop assistant that uses learning technology to identify relevant information on the workstation. CALO Express finds and organizes information in email, on a workstation, and on shared drives, enabling higher-level assistance with tasks such as quickly assembling new presentations from existing material and gathering relevant documents for meetings. *(Being evaluated in NMCI)*

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Contact Management uses learned models of user web pages to find online contact information such as addresses, phone numbers, and expertise keywords, given a person’s email address.

Form Online Analyzer and Manager (FOAM) presents ranked suggestions for completing web-based forms based on cross-field models learned from prior form-filling episodes. This contextualized learning enables more accurate suggestions for forms with dependencies among fields than is possible with single-field history mechanisms.

Meeting Assistant captures speech and online chats during a meeting to provide a transcript with coordinated audio that serves as a permanent, annotatable record of the meeting. Meeting Assistant transcripts can be searched and quoted like other textual documents, enabling search-engine analysis of archived meetings.

PrepPak finds related objects for a target object within a workspace. For instance, PrepPak can help prepare for a meeting by suggesting email, documents, and contacts of relevance to the meeting. PrepPak’s algorithm for relevance ranking refines its suggestions over time based on user feedback on suggested artifacts.

Probabilistic Consistency Engine (PCE) combines possibly conflicting evidence from a collection of data sources into a most probable hypothesis consistent with evidence. PCE takes as input a collection of facts and weighted rules and generates the marginal probabilities of individual atoms and formulas, using mechanisms based on Markov Logic Networks.

Time Manager is a personalized calendar management assistant that handles email meeting requests, reserves venues, and schedules events. Time Manager learns user preferences unobtrusively over time by observing user decisions with respect to options presented for scheduling meeting requests. The system interfaces with commercial enterprise calendaring platforms and operates seamlessly with users who do not have Time Manager.

Workflow Activity Recognition and Proactive Assistance (WARP) recognizes the user intent by matching observations of user actions to predefined models of workflows. WARP employs Logical Hidden Markov Models to support the recognition and tracking of hierarchical, interleaved workflows in domains that may involve hundreds to thousands of objects.

Learning Methods

Classification assigns individual items to discrete groups prespecified by the user, based on features of the items. The PAL classification module provides a unified API for three classification algorithms: Transformed Weight-Normalized Complement Naive Bayes, Maximum Entropy, and Decision Trees. (Deployed in WebTAS; being evaluated in SKIWeb and ISPAN GAP CIE)

Clustering organizes objects into groups based on their similarity, as evaluated by comparison of designated object attributes. The PAL clustering module provides a unified API for three state-of-the-art clustering algorithms: Latent Dirichlet Allocation, Lingo, and Katz. (Deployed in WebTAS; being evaluated in SKIWeb and ISPAN GAP CIE)

Semantic Extraction learns from training examples to recognize entities and semantic meta-structures such as names, addresses, and structured phrases from a body of text. (Deployed in WebTAS; being evaluated in SKIWeb and ISPAN GAP CIE)

MALLET (MAchine Learning for Language Toolkit) provides a range of machine learning capabilities applied to statistical natural language processing mechanisms, including document classification, clustering, and information extraction. (Being evaluated in SKIWeb and ISPAN GAP CIE)

MinorThird provides methods for storing, annotating, and categorizing text as well as learning to extract entities.

Learning Support

Instrumentation and Automation records and executes a broad set of events for Thunderbird and Firefox. Instrumentation and Automation tasks include composing and sending emails, attaching documents, and browsing URLs.

SideBar UI provides flexible interface capabilities for interacting with PAL learning components. SideBar UI includes widgets for collecting user feedback, responses to suggestions, and status information that can drive learning components.

MORE INFORMATION

To learn more about the PAL components and to review examples of applications and API documentation, visit the PAL web site: http://pal.sri.com