

Proposal for a CLIPS Software Library

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Abstract. This paper is a proposal to create a software library for CLIPS, the C Language Integrated Production System expert system shell developed by NASA. Many innovative ideas for extending CLIPS were presented at the First CLIPS Users Conference, including useful user and database interfaces. CLIPS developers would benefit from a software library of re-usable code. The CLIPS Users Group should establish a software library--this paper proposes a course of action to make that happen. Open discussion to revise this library concept is essential, as only a group effort is likely to succeed. At the end of the paper is a response form intended to solicit opinions and support from the CLIPS community.

ANALYSIS OF THE CURRENT SITUATION

What kinds of software developed by one CLIPS programmer may be useful to others? How can they apply it to their own needs? Who would use a library, and who would support it? How hard is it to maintain and distribute software for a wide ranging user group, and what resources are available? Answers to these kinds of questions define the functional and operational requirements for a library facility.

Library Participants

NASA's open sharing of CLIPS with the public seems to have attracted interest primarily from university researchers, industry (IR&D) researchers, and small government-funded projects. There may also be a substantial number of PC and Macintosh users who have tinkered with CLIPS but are not really expert system developers. Together, these four overlapping groups are the "customers" or potential users of the software library; most of the good ideas and resources will come from them. There are several CLIPS-based products now available¹ or in prototype form, but commercially oriented developers are not likely to participate in a not-for-profit software library effort.

Resources

CLIPS users, NASA/JSC's Software Technology Branch (STB, the CLIPS development team), and expert systems research interests constitute the resources available to implement a software library.

The motivation for a CLIPS software library is the belief that a number of CLIPS users are willing to share their code, which would provide a great resource to other expert system application developers. The 82 papers presented at the First CLIPS Conference² provide evidence that such code is available. A survey of these papers shows about two-thirds have some re-use potential, either in the form of generic CLIPS extensions, improved user/developer environments for a particular hardware platform, or user-friendly "smart" front ends for specialized software packages. Several of these were in fact designed as generic interfaces, using formal or de-facto standards such as SQL, dBase III, and Hypercard. Most authors appeared willing to share their developments; at least seven authors made their code available at the Conference and several sent out softcopies shortly afterward.

If each author at the First CLIPS Conference represents ten others who did not contribute only for lack of time or money, then there are nearly a thousand potential contributors. This significant pool of talented people is the most important resource of the CLIPS software library. Creating a library could stimulate the CLIPS community to develop desirable re-usable functional extensions by encouraging them to consider generic requirements in designing and coding their applications.

Volunteers to maintain and distribute the software are a crucial resource. With sufficient motivation, the CLIPS Users Group should be able to staff a simple software library. Those most interested in obtaining library software might be harnessed to do most of the work. CLIPS users should be invited to participate, and the Library should exploit existing resources to the maximum practical extent.

Access to computers and data communications are key resources to implement a software library. Virtually all CLIPS users have access to computers of some kind, and usually there are few restrictions to using these computers after hours to support worthwhile activities. Access to data communications is less universal, but most users could at least find a PC with a modem so using electronic bulletin boards (BBSs) seems feasible. In addition to the existing JSC Software Support BBS, there may be other BBSs belonging to Group members.

NASA is interested in supporting CLIPS applications, but in these times of severe funding constraints it is difficult for public agencies to rationalize support for a small special interest group. Hopefully STB is already doing everything possible to further develop the CLIPS shell, in addition to providing COSMIC funding and sponsoring user conferences. COSMIC, in turn, has published the CLIPS newsletter for its first year to help foster an active users group. Although NASA and COSMIC participation is highly desirable, neither group should be expected to provide direct support beyond their current activities.

LIBRARY SPECIFICATION

Software Requirements

Ideally, the CLIPS software library would provide a programming resource packed with useful, portable C source code with concise but easily understood documentation. An excellent example is the blackboard extension BB_CLIPS developed by Orchard and Diaz³, supported by the National Research Council of Canada. They responded to user requests at last year's Conference by distributing (at no charge) their C source for BB_CLIPS with detailed, well organized documentation and test files to support user compilation. Included with BB_CLIPS were files and documentation for FZ_CLIPS, a CLIPS extension for fuzzy logic reasoning. Even just an improved CLIPS executable with brief application notes holds potential for PC users; Marsh's graphical modeling shell ISA⁴ provides an environment for graphically representing objects and linking to the CLIPS engine.

The CLIPS developer/user community is best served by establishing some requirements for submitting and reviewing candidate software. One possible set of software authorship goals is:

- Reliable operation in the intended operating environment

- Generic functionality - ease of use/adaptation

- Thorough documentation of user features

- Architecture discussion for other developers

- No license/restrictions imposed by author

Of course, submittals would not have to excel in every category to be useful to others and worth cataloguing. All submitted software should be reviewed, tested as appropriate, objectively assessed, and then posted for dissemination to the CLIPS community.

Software Assessment

Software assessment should include operational testing and evaluation of the software's potential for re-use or adaptation to new applications. Operational testing involves executing test cases, such as example knowledge bases or script files of new commands, to ensure the software performs as defined by the author. If the program code is supposed to be portable, test it on several common hardware platforms such as a PC, a UNIX workstation, and a VAX. If it provides a graphical user interface for a particular platform, test it on several different machines. For PCs, the normal variations in memory size, monitor, keyboard, and mouse interface can lead to unexpected problems. The assessment effort also should explore human factors, hardware and software limitations, and the range of potential applications or adaptation by other uses.

Feedback from the user community is valuable to both the library user and the author; the software review process should be responsive to the needs of both. This is vital to establishing a conduit of common interest that will support sustained library operation. The author should be provided two avenues of feedback: confidential technical feedback from the library's initial

technical review, and access to user comments after release. The reviewers should leave ample opportunity for the author to address their comments prior to software release, in respect to the author for his contribution. After release, the library should provide the users with a history of bug reports, work-arounds, and related developments. Authors should be provided names and addresses of people who have requested their software, unless the library takes responsibility for contacting people about support and revisions.

Distribution

Once CLIPS-related software has been received, reviewed, and posted for dissemination, there needs to be one or more mechanisms for distributing software. Requirements for distribution include:

- Direct costs not exceed available funding

- Controlled but easy access by the users

- Support user feedback and author revisions

Containing costs is paramount. Many, if not most, CLIPS users seem to have considered low cost an important criteria in their initial selection of the CLIPS expert system shell. Later they probably found CLIPS's functionality, excellent documentation, portability, and extensibility to be important in building and eventually delivering their application. Still, the costs of a library facility should be in line with the "almost shareware" price of the CLIPS expert system, a big factor in its popularity. Minimizing user costs to make the library operation self-supporting greatly increases the feasibility of continued operations.

User should be able to access the library files easily, but this needs to be carefully controlled to prevent abuse and unauthorized use by non-members. Assigning a unique number or password for each user would provide a reasonable level of security, and is compatible with manual and electronic distribution methods. Some security provisions are also necessary to ensure the library facility can control and coordinate user comments, feedback to the authors, and dissemination of revisions to the right people. There would be little incentive for members to pay a usage fee for a software package if they knew subsequent revisions would be freely available.

User feedback is a most important benefits to the authors. Some mechanism should be established to collect comments which is simple and easy to use to encourage feedback. Distribution channels should be designed for two-way communication, whether on paper or in electronic form. If an author chooses to revise the software, the distribution system should support re-distribution with little additional effort on the part of the author.

PROPOSED CLIPS SOFTWARE LIBRARY

Strawman Approach

The proposed software library Strawman concept would create a self-supporting facility to collect, classify, and distribute CLIPS-related code for re-use by other expert system developers. However, the analysis and ideas presented in this paper are tentative at best. This "strawman" approach is intended to stimulate discussion and voluntary action within the CLIPS user community, especially members of the newly-formed CLIPS Users Group.

Organization

The CLIPS software library would be supported by four overlapping groups: a managing body, a team of technical reviewers, the general membership, and contributing authors. The managing body could be a standing CLIPS committee staffed by a few dedicated volunteers. Library Committee volunteers would do most of the work required to organize the overall effort; establish and maintain Library policies; solicit contributions and interface with authors; regulate the review process; and organize, store, and distribute the software.

Reporting to the Library Committee would be a pool of technical reviewers, experts with access to various computer systems. Hardware expertise should include PCs, Macintoshes, workstations, VAXes, and possibly mainframes and supercomputers. Operating systems should include DOS (with and without Windows), Finder, UNIX, and VMS. Areas of functional expertise should include software design and testing, C language programming, human factors analysis, technical support and documentation, and of course expert system development. Initially, only some of the desired expertise will be volunteered; the Library Committee should strive to assemble a well-rounded pool of experts.

Since the Library Committee would be a part of the CLIPS Users Group, the baseline approach is to consider everyone in the CLIPS Users Group as a member of the Library. This provides a added benefit for being a member of the CLIPS Users Group, although it may discourage a few "free spirits" who don't join organizations as a matter of principle. Authorship should have no Library-imposed restrictions; there is already pressure from some employers to avoid complete disclosure of ideas. A positive incentive of one year free membership in the CLIPS Users Group could be offered to make authors' efforts worthwhile.

Operations and Coordination

To minimize costs for Library users, the costs of daily operations should exploit existing resources as much as possible, including telephones, existing networks, and dial-in PC/Mac-based BBSs.

Since the CLIPS Users Group is geographically scattered and financially limited, the Library Committee must employ electronic communications to organize and implement their objectives. Teleconferencing and facsimile transmission can provide the necessary interaction to coordinate

even complicated interactions. The Library Committee should use telephone conference calls, perhaps bi-monthly, to coordinate their efforts. A baseline approach is to use the NASA/JSC Software Support BBS as the backbone network for author uploads, reviewer interaction, and user downloads, under special access control per Library Committee policy. By assigning each CLIPS Users Group member a control number, their access privileges can be easily managed to meet Library guidelines. A NASA/STB representative should be actively involved in this process to ensure NASA consent in the use of this public-funded BBS.

Library listings should be available by mail or by modem from BBSs. A primary source would be the NASA/JSC board but other potential sources include boards/networks supported by CLIPS Users Group members. Access to Library software could be as simple as dialing the nearest BBS, providing a membership identification number, and downloading released source code and documentation. Privately supported BBSs should be persuaded to enforce Library policies.

Access to the software library is likely to increase the paid membership of the CLIPS Users Group, so perhaps some of the membership fees could be allocated to support Library Committee activities. However, the CLIPS Users Group is a fledgling organization that needs resources to grow; all direct costs should be factored into a usage fee charged for each Library software package.

Software Solicitation and Review

The Library Committee should exploit whatever opportunities are available to solicit material and membership. The CLIPS Users Group newsletter, newsCLIPS⁵, is one avenue to reach potential authors. newsCLIPS may also be willing to publish information or short articles on new releases. Some professional trade magazines accept informational announcements and may prove otherwise helpful in reaching a wider audience (including those thousands of others who have "tinkered" with CLIPS).

When an author contacts the Library Committee, the Chair should assign one Committee member as the author's agent. The responsible agent would collect the material from the author and determine how it should be assessed. The Chair would assign one or more technical reviewers per the agent's recommendations. The review time should be as short as possible, and the agent would be responsible to coordinate among the technical reviewers and expedite the review process.

This software review process will benefit both the library user and the author. The rights of the authors are considered foremost--they should review all test findings, revise their submission if desired, and have the right to make a final decision on releasing the software. This means that during the review process the software must be handled in confidence. The author should be told who will test his software and the test team should be obligated to keep the software and its test results private. One means to implement this would be special BBS/network access privileges.

The agent should ensure that the author has reviewed the test results and any additional findings of the test and evaluation effort, then get the author's final consent on a standard form. The standard form should consent to a legal position on ownership and distribution rights, and

minimize liabilities. Finally, the agent should submit the material to the library for storage and distribution.

Ownership and Usage Rights

The degree to which the library owns the donated software should be thoroughly discussed with potential authors and the CLIPS community at large. One position would request the author to sign over his copyright to the Library. Some research supported by corporate or government sponsorship may stipulate certain kinds of restrictions on how the software is used (e.g. non-commercial use only). Library members could be asked to sign a limited distribution agreement to prevent secondary distribution. However, authors should act on the principal that the software is a donation to the CLIPS community, intended to empower others to freely exploit and further develop their code. The library effort would be improperly burdened to support any profit-oriented venture.

The Library Committee should establish the extent to which ownership and usage restrictions are acceptable. As one of its first duties, the Library Committee should draft a formal ownership document that spells out the rights of the author and library members; there may need to be several versions to meet the needs of individual, university, government, and corporate participants.

Direct Costs

If software media are provided by user and labor is provided by volunteers, the only remaining necessary distribution direct costs are reproduction and postage. For relatively small changes to the standard CLIPS syntax, user documentation could be furnished in ASCII soft copy (tape or floppy disk), which reduces reproduction costs to almost nothing. A distribution volume of perhaps two requests per user per year could require 20-100 copies per month, produced by perhaps 10-20 hours effort.

If the requestor supplies the required media (per the COSMIC model), distribution direct costs should be on the order of \$1 per disk/Mbyte and 5-10 cents per page of paper documentation (if necessary for complex programs). These estimates include mailing a tape or several floppy disks (postage, mailer, and labels) and paper documentation (copier, additional postage, paper and envelopes). Distribution direct costs should be borne by the requestor.

Other Library Committee Tasks

The library should additionally be chartered to promote CLIPS and its applications in any aspect that seems feasible. As an adjunct to its primary tasks of review and distribution, the CLIPS software library should seek leverage from existing interest in CLIPS, expert systems, and general IR&D to promote the library concept and solicit new inputs. Exploiting opportunities to promote CLIPS will serve the common interest.

CONCLUSIONS

The analysis and discussions presented in this paper support the following conclusions:

A significant pool of re-usable software could be made available to CLIPS expert system developers at low cost. The software is out there, as demonstrated at the First CLIPS Conference. The new CLIPS Users Group might be willing to support a basic library facility.

Cooperative synergy between authors and users provide rewards to both. Feedback from the evaluation process and end users provides a valuable Beta-test to the author, and provides CLIPS developers/users with a source of documented and tested code.

Minimal additional support is required to implement a library facility. Modest usage fees, access to several existing BBS/networks, and a few active volunteers may be all that is needed to implement a software library.

RECOMMENDATIONS

The following recommendations are based on the presented analysis and conclusions:

The CLIPS Users Group should actively support a library facility. They should elect or appoint a Library Committee Chair and solicit volunteer from the membership. Issues such as library membership and software ownership should be resolved as soon as possible.

The library should minimize costs. The CLIPS user community is cost-sensitive. The library staff should minimize costs and leverage on existing interest in CLIPS, expert systems, and AI.

Those interested in participating in a software library should complete the form at the end of this paper. The survey results will be presented to the CLIPS Users Group if strong support is indicated.

REFERENCES

1. ECLIPSE, distributed by The Haley Enterprise, 413 Orchard St., Sewickley PA 15143. (412) 741-6420
2. Proceedings of the First CLIPS Users Conference, Vol. I and II, held at Johnson Space Center, Houston, Texas August 13-15, 1990. Published by COSMIC, Univ. of GA, 382 E. Broad St., Athens, GA 30602. NASA Conference Publication 10049.
3. Orchard. R. A., and A. C. Diaz, "BB_CLIPS: Blackboard Extensions to CLIPS", First CLIPS Conference Proceedings (Vol. II), pp. 581-591. Contact Orchard at Knowledge Systems Lab, Building M50, Montreal Rd., Ottawa, Ontario (Canada) K1A 0R6, orchard@ai.iit.nrc.ca
4. C.A. Marsh, "A PC Based Fault Diagnosis Expert System", First CLIPS Conference Proceedings (Vol. II), pp. 442-458.
5. newsCLIPS is the newsletter of the CLIPS Users Group, published by Dr. Linda K. Cook, Lockheed AI Center, PO Box 7732, Menlo Park CA 94026-7732; cook@netcom.com

CLIPS Software Library Response Form

This form is intended to solicit ideas, opinions, and voluntary support to create A CLIPS software library. Please indicate your degree of interest by answering the following questions.

Do you favor the creation of a CLIPS software library?

Yes No

Do you think some portion of the CLIPS Users Group membership fees should be allocated to support a software library, and if so, how much?

Yes, ____ % No

Do you feel library membership should include people who are not members of the CLIPS Users Group?

Yes No

Would you participate in a library as a member, with privileges including low-cost access to software?

Definitely would Might Would not

Would you participate as a contributing author, including donating your software and documentation?

Definitely would Might Would not

Would you volunteer some time as either a Library Committee member or technical reviewer?

Definitely would Might Would not

If interested in performing technical reviews, what operating systems and hardware platforms do you understand well and have access to?

Do you own/operate a network or electronic bulletin board service which may be used to support library efforts? Yes No

Other comments:

Name, address, and phone number (voluntary):