NAME

userBasis − user supplied ALP basis function set

DESCRIPTION

The ALP generator **alp**(1) can work with a user supplied set of basis functions. These functions are implemented by a single C++ function named **phi**() with the prototype

```
extern "C" double phi(int j, int x[], int n);
```

The first parameter *j* is the basis function index; indexing begins at 1. The array *x*[] represents the current state. This function should assume that the entries *x*[1] through *x*[*n*] are defined. The final parameter *n* is the dimension of the state space.

A second function **numberOfFunctions**() must also be defined to return the number of functions in the basis. The prototype is

```
extern "C" int numberOfFunctions(int n);
```

where *n* is the state space dimension (i.e. the number of classes in the network).

It is important to note that all basis functions should be bounded by a quadratic function; i.e., have no more than a quadratic growth rate.

EXAMPLE

The following C++ source code implements quadratic and linear basis functions to approximate the differential cost with $h(x) = (1/2)x'Qx+p'x$:

```
// Returns the number of functions in the basis.
// Parameter n is the dimension of the state space

extern "C" int numberOfFunctions(int n = 0)
{
    return n * (n + 3) / 2;
}

// Returns the value of the jth basis function
// (first function is j = 1) evaluated at state
// (x[1], x[2], ..., x[n]).

extern "C" double phi(int j, int x[], int n)
{
    int nQ = (n * (n + 1)) / 2;

    if (j <= nQ)
    {
        // quadratic terms
        int i = 1;
        while (j - 1 >= n)
        {
            j -= (n - i++);
        }
        return (i == j ? 0.5 * x[i] * x[j] : double(x[i] * x[j]));
    }
    else if (j <= nQ + n)
    {
        // linear terms
```

```
                int i = j - nQ;
                return double(x[i]);
            }
            return 0.0;
        }
```

SEE ALSO

alp(1)

AUTHOR

Christopher Pfohl wrote the code to support a user supplied basis. This document was written by Jonathan Senning.