Figure 2.14 summarizes the register conventions for the MIPS assembly language. This convention is another example of making the **common case fast**: most procedures can be satisfied with up to 4 arguments, 2 registers for a return value, 8 saved registers, and 10 temporary registers without ever going to memory.

Name	Register number	Usage	Preserved on call?
$zero	0	The constant value 0	n.a.
$v0–$v1	2–3	Values for results and expression evaluation	no
$a0–$a3	4–7	Arguments	no
$t0–$t7	8–15	Temporaries	no
$s0–$s7	16–23	Saved	yes
$t8–$t9	24–25	More temporaries	no
$gp	28	Global pointer	yes
$sp	29	Stack pointer	yes
$fp	30	Frame pointer	yes
$ra	31	Return address	yes

FIGURE 2.14 MIPS register conventions. Register 1, called $at, is reserved for the assembler (see Section 2.12), and registers 26–27, called $k0–$k1, are reserved for the operating system. This information is also found in Column 2 of the MIPS Reference Data Card at the front of this book.

Elaboration: What if there are more than four parameters? The MIPS convention is to place the extra parameters on the stack just above the frame pointer. The procedure then expects the first four parameters to be in registers $a0 through $a3 and the rest in memory, addressable via the frame pointer.

As mentioned in the caption of Figure 2.12, the frame pointer is convenient because all references to variables in the stack within a procedure will have the same offset. The frame pointer is not necessary, however. The GNU MIPS C compiler uses a frame pointer, but the C compiler from MIPS does not; it treats register 30 as another save register ($s8).

Elaboration: Some recursive procedures can be implemented iteratively without using recursion. Iteration can significantly improve performance by removing the overhead associated with recursive procedure calls. For example, consider a procedure used to accumulate a sum:

```
int sum (int n, int acc) {
  if (n >0)
     return sum(n - 1, acc + n);
  else
     return acc;
}
```

Consider the procedure call sum(3,0). This will result in recursive calls to sum(2,3), sum(1,5), and sum(0,6), and then the result 6 will be returned four